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VIEW

OF THE

MILITARY FORCE

OF

GREAT BRITAIN.

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VIEW

OF THE

HISTORY AND ACTUAL STATE

2538

OF THE

MILITARY FORCE

OF

GREAT BRITAIN.

BY

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STUDIES AND WORKS OF THE ARMY.

BOOK VII.

OF THE MORAL FORCE OF THE ARMY.

CHAPTER I.

Intelligence and Character—Religious Feelings and Practices.

Men usually judge of the valor of troops by the events of war. A victorious army always appears heroic, whilst one less fortunate seems by its discomfiture to evince its cowardice. Thus, when the English troops won the victory of Blenheim, they ranked with the most valiant of Europe; and, after the defeat at Fontenoi, the capitulation of the armies of Burgoyne and Cornwallis compelled to surrender by Gates, Washington, Lafayette and Rochambeau, and more especially, after the reiterated defeats in France, Belgium, and Holland, the whole world regarded the English soldier as incapable of

facing the warriors of the martial nations of Europe. Our government immediately availed itself of this gross prejudice to inspire our armies with a sovereign contempt for the English forces. To doubt the defeat of an army, sent by the British ministry to any part of the continent to contend against our troops, would have been imputed to disaffection.

In the mean time, the expedition to Egypt took place; and a French general, whose incapacity rendered him an unfit successor of the two great captains who had preceded him, imprudently attacked the troops he despised, and Egypt was lost. Some years after, General Stuart disembarked on the coast of Calabria; and General Regnier, who commonly knew so well how to unite prudence with courage, was rashly blinded by confidence, and, fearing lest an enemy so easy to vanquish might escape him, did not permit his troops, already exhausted with fatigue, to take breath, and the result of the contest discovered that he had imprudently undervalued his enemy. The same persuasion of the inferiority of the English army caused the troops of Junot to lose the battle of Vimiera, and consequently the possession of all Portugal.

But here I pause; for, in recalling these unfortunate epochs, I only wish to show, how

fatal it always is to deceive troops by inspiring them with a blind contempt of their opponents. It is more noble, and even safer, to say to warriors: Soldiers! you do not march to an easy conquest; I lead you to a formidable enemy whom, therefore, it will be glorious to conquer. To-day you may acquire true glory by your valor; prepare, then, for exploits worthy of you, and, above all, do not reckon on any success unless obtained by efforts which themselves will be your most splendid reward!

After showing how far we have been deceived with respect to the courage of the English troops, it is proper to consider their character. Their bravery, in general, is less brilliant, impetuous and bold, than that of our warriors, but it possesses all the energy of endurance. Yet it is by firmness, not less than by intrepidity, that, in the bloody conflicts of nations, victory is finally obtained, especially with the arms at present in use. If, during the last twenty-four years, the French have become the most active military people in Europe, the English may indisputably claim the next rank, which they have attained in a manner peculiar to themselves. Their activity has not that prodigious elasticity of which we have given so many memorable examples; but it never suffers any interruption, and continues

unchangeable. This characteristic activity produces, at the end of a given time, a sum of results greater than could have been foreseen from the contemplation of an isolated action even of the greatest brilliancy.

The British soldier has less natural spirit and penetration than the French; but the immobility of his imagination renders his actions more measured.* Less diverted by the view of external objects, by the recollections of the past, and by the hopes or terrors of the future, he preserves an unshaken presence of mind. He atones for his inferiority of intelligence by prompt attention to command. Incapable of judging of the great movements which are executed, much less of those in agitation, he does not even think of dangers to come. He rushes to instant death without bestowing a thought on the future; and this is the reason why the moral energies of the British army are indestructible by ill fortune. The want of foresight which seems to characterise the English soldier, the oblivion of past misfortunes, the carelessness about those before him, these qualities, so valuable in well-directed troops, are counterbalanced by defects of a destructive

* A novel and amusing explanation of the cause of the firmness evinced by our troops under danger. May their imagination be ever thus immoveable!—*Tr.*

tendency. A brutal desire of temporary enjoyment leads the British soldier into excesses of debauchery and inebriety. When he arrives at places where wines or strong liquors are to be procured, nothing can restrain him; neither the noble desire of marching to victory, and of completing it by pursuit, nor, in case of retreat, the fear of being surprised by the advancing enemy. He will drink to his immediate destruction if nature do not paralyze his insatiable thirst by suspending all his faculties.

During the wars of Spain and Portugal, the general in chief of the British armies constantly made the greatest efforts to banish, or, at least, to diminish, the frequency of this most unmilitary vice. When the troops, for instance, had considerable arrearage to receive, he caused it to be daily distributed to them in such quantities, as only sufficed to appease real wants, and procure moderate pleasures.* Formerly,

* The Duke of Wellington, in his orders of the day, dated at Fuente Guinaldo, 4th June, 1812, promulgates to the British army the loss of several soldiers from intoxication, and expresses himself in the following manner: "The Commander of the forces regrets to add that this is not the first instance where soldiers have perished from drunkenness. He trusts the knowledge of the immediate and fatal effects of drinking to excess will render the soldier a little more moderate in this respect."

In the orders of the day dated at Cuellar, 1st of August, 1812, the same illustrious chief prescribed the following measure of

the English officers very generally participated in this shameful vice; but by the progress of a discipline, as wise as it is severe, a thorough reformation has, in this respect, been effected.

Another effect of the want of foresight in the lower orders of England is visible in the great number of enlistments for life. Ever since the establishment of limited service, the number of civilians enlisting for life has been ten times, and, in drafts from the militia, three times greater, than that portion who have availed themselves of the limitation. Without reflecting on the doubly advantageous opportunity always afforded at the expiration of the first engagement of entering on a second, the hope of getting immediate possession of a guinea more is sufficient to determine them to sell their liberty for ever. The Scotchman, much more prudent than the Englishman, and more careful of his true interests, enlists far less fre-

precaution: "As a great part of the sickness of the army is attributable to the use of strong liquors during the hot weather, the commander of the forces directs officers to cause, at the moment of delivery, the liquor apportioned to each mess in their respective companies, to be mixed with four times the quantity of water." But this proportion of water having been found by the soldiery much too large, it was reduced a few days after to three times, instead of four times the quantity of strong liquor.—*Author*.

quently for an unlimited period; and on the contrary, almost all the Irish who enter into the service, enrol themselves for life, as we have had occasion to remark in a former part of this work.

The military service of the Roman empire rested on the basis of an oath, which was productive of very beneficial consequences, because the military oath in Rome made, in fact, a part of the religion of the people. This is no longer the case with modern nations, and, therefore, that solemn obligation has lost its admirable influence.

In England, where religious ideas have a very great control over the avowed acts of public authority, all means are used to subject the army to the same influence. Like the Roman, the English soldier, on ranging himself under the standard, takes an oath to the prince; but which he is far from adhering to with the same tenacity; and he not unfrequently deserts, often even to the enemy.

Lord Wellington says, in the accustomed style of the orders of the day: "The commander of the forces regrets to have observed the number of soldiers who have of late endeavored to desert to the enemy. He hopes that this caution will prevent a repetition of a crime which has become but too common, and which

until latterly, was unknown to the British army. *Lezaca*, 14*th October*, 1813."

Thus, at the moment of our greatest disasters, and when our armies were annihilated a second time in the plains of Leipsic, the desertion of the English troops encreased in a degree to alarm, or at least, to distress their general. The military oath has not always been administered in the same form, and was originally framed by the Stuarts, as a species of religious engagement, by which the ends of despotism might best be served. It is still remarkable for its imperative and servile tone.

"I, N. enrolled to serve in the troops of His Majesty, or in those of the East India Company, according to the pleasure of His Majesty, swear, that I will bear to our Sovereign Lord, King George, faithful and true allegiance; that I will defend him, as I am in duty bound, in his person, in his crown, and in his dignity against all his enemies; and that, as long as I remain in the service of His Majesty, I will duly obey the orders of His Majesty, as well as the orders of the Generals and Officers placed over me by His Majesty, &c."

If a tyrannical monarch were aided by a religious soldiery, under the influence of an oath of a similar tenor, no public liberty, nor constitution, could be saved from forcible subversion.

But here, as in all human institutions, manners are more powerful than oaths, or rather they give to oaths a sense which the letter does not convey. And history will justify the assertion, that the English soldier would not believe himself bound, in any manner, by the obligation of his oath to fight against the parliament, even though the King should be pleased to place its members among the number of the enemies of his dignity, his crown, or his person.

We must show, however, by what means the government has endeavoured to encourage religious sentiments in the interior of regiments. Formerly it was usual in the English army to appoint a chaplain to every regiment of infantry or cavalry in the regular troops, militia, or fencibles. The duty of the chaplain was to follow the corps under all circumstances, and to perform divine service in *person*. By degrees, however, the regimental chaplains obtained leave of absence, continually renewed, and their places ended by being considered as sinecures. Every chaplain caused the duties of his situation to be fulfilled by a deputy,* with whom he stipulated at the lowest price.

In 1795, General Abercromby, preparing an expedition against our American possessions,

* The poor deputy generally received from the nominal chaplain the pay of a serjeant of infantry.—*Author.*

promulgated an order to the chaplains of all the corps of his army to repair to head-quarters, to agree upon the number of their body who should accompany the troops. But the reverend gentlemen earnestly represented, that they had purchased their religious employments with a perfect understanding, and according to a formal promise, that they were never to be called upon to serve personally, provided they engaged a deputy. Not a single chaplain consented to repair to head-quarters.

In 1796, to put an end to this scandal, occasioned by the ministers of the English church, a warrant from the King declared, first, that the chaplains, who should not rejoin their corps three months after the receipt of the order to that effect, should retire on an allowance of four shillings per diem; secondly, that the difference between the retired allowance and the full pay should be employed to pay the chaplains who would consent to perform their sacred functions with their corps. From that time, chaplains were no longer permitted to sell or exchange what, in contempt of the laws and of their conscience, they pretended to be sinecures; and, to encourage the ecclesiastics to fulfil the duties of their calling, it was resolved, that chaplains serving with their corps in Great Britain, should receive seven shillings per day, and they who

followed their regiments on foreign service, should be entitled to ten shillings a day. In the mean time a chaplain-general was created, to establish some discipline among these ci-devant sinecurists. The only one of their body who had consented to follow the English army during the campaigns in Flanders of 1793, 1794, and 1795, was selected for this office.

The chaplain-general belongs to the staff of the army, and is immediately under the orders of the commander-in-chief. But the chaplains of the corps of artillery and engineers being of the ordnance department, are not under the authority of the chaplain-general.

As the nomination of chaplains used to belong to the colonels of regiments, who sold these situations, the government, from what was called a spirit of equity, had the folly to give £700 to colonels of cavalry, and £500 to colonels of infantry, to indemnify them for the loss of a branch of their commerce.

The chaplains are chosen at present with particular care, and by the first prelates of the kingdom. They are obliged by regulation to visit the sick, and the hospitals of their respective brigades or garrisons, at least twice a week, to perform their sacred duties, as ordained by the English church; and, lastly, they are required to officiate on Sundays, for the be-

nefit of the troops. Chaplains are enjoined to repeat the service of the different corps of the garrison, or of the division in succession, and care is to be taken, that a greater number of troops than the voice of the preacher can reach, be not assembled at one time to hear divine service, which must be concluded with a sermon, directed towards practical duties, and adapted to the habits and intelligence of the soldier. The commander-in-chief, say the regulations, attaches great importance to this latter part of the service, because it is conformable to the usage of the established church, and more than ever requisite at a moment particularly distinguished by the inteference of sectaries of every kind. Soldiers are required to attend divine service with their side-arms, and be conducted in regular order to and from church.

By an order of the 18th of January, 1812, general officers on the home, and on foreign service, are desired to state, in their reports to the commander-in-chief, whether the chaplains have fulfilled the duties prescribed to them; and whether they have performed divine service every Sunday, for all the corps separately.

Commanders of corps must, before their final departure from any post, take a certificate from the clergyman of the place, to attest that the

men under their command have performed their religious duties. The chaplain-general has to furnish chiefs of corps with the form of these certificates; and none of the duties specified in them can possibly be dispensed with, but in cases of absolute necessity. The King has placed religious books at the disposal of the military hospitals, in order that the soldiers may avail themselves of them whenever the state of their health permits.

Notwithstanding the zeal of the government for the established religion, which must be so much the greater, in consequence of the prince being invested with the character of Supreme Pontiff, the intolerance of the executive power towards the Catholics diminishes daily. The chiefs of corps are enjoined to take particular care that no soldier, professing the Catholic religion, be punished for not attending divine service, as performed by the church of England. It is desired, on the contrary, that he may have perfect liberty to enjoy the exercise of his own religion, whenever it can be done without interfering with the indispensable duties of the service.

CHAPTER II.

Honorary Rewards—Corporal and other Punishments.

When an empire permanently supports a large army, whatever may be the public wealth and national generosity, it is impossible to bestow on all the officers, who have merited well of their country, pecuniary rewards, sufficiently great to counterbalance the fatigues and dangers of the military profession. Honor is the only treasure which, distributed with impartial justice, remains always inexhaustible. When honorary rewards are the exclusive price of distinguished efforts and illustrious actions, every single mark of distinction enhances the value of those gifts in store for fresh exploits. A simple, but eloquent eulogium, pronounced in the name of the country, is often an ample acknowledgment of eminent services; and while it perpetuates the recollection, serves to inspire the love of noble deeds. Such were the panegyrics spoken at the end of each campaign by the orators of Athens, in honor of warriors who had died for their country. "Praises," said Pindar to the Greeks, assembled to do honor to the renown of their celebrated countrymen, "praises

are the meed of noble actions, and are as beneficial to the growth of virtue, as the dew of heaven is to that of plants."

The parliament of Great Britain, in passing its votes of thanks, employs with dignity the same means as those of antiquity, to recompense the valor of the soldiers, the officers, and the victorious generals. Another way of perpetuating the recollection of services rendered to the state, is to permit the individual to wear some exterior token, which should daily call forth the respect and gratitude of his fellow-citizens.

In the institution of the several orders of chivalry, the modern European governments seem to have had this object in view. Like the ring of the Roman knights, these orders were first exclusively reserved for privileged ranks. Soon after, such a badge served, like the cap of the freed man, to mark the elevation of the vassal and the peasant to the class of men truly free, that is, to the order of nobility. When knights ceased to form a chosen body in armies, the distinctions of the orders degenerated into baubles of vanity; and troops remained a long time without rewards capable of stimulating to great actions. Among some nations, the modern orders of knighthood approximate, in a degree, to those true principles which

should be our guide in the distribution of military rewards: but, with an absurdity worthy of barbarous states, potentates have attached the greatest honors to those distinctions, to obtain which, the only qualification requisite, is a long series of privileged ancestry. The order founded on merit almost universally holds a secondary place to that reserved for high birth, and, therefore, peers have blushed to receive the decoration of the order of St. Michael. Hence, also, the Legion of Honor has yielded to the order of the Holy Ghost; and constitutional France affords the singular spectacle of an order holding, according to the ideas of the court, the first place in the scale of honorary rewards, which, from its nature, cannot be bestowed on any one of the marshals, whose exploits, during thirty years, raised France to the pinnacle of glory.

The orders of the Garter, of the Thistle, and of St. Patrick, are to England, Scotland, and Ireland, what the order of the Holy Ghost is to France: but, in an empire where personal merit may, almost without effort, elevate to the highest dignities, men eminent by their services are first created peers; and even, though they cannot show a long line of genteel ancestry, they are afterwards chosen knights of the privileged orders. The three orders above mentioned are not sufficiently numerous; and

they contain too few military names on the list of their members, to justify their being regarded as a part of the rewards capable of having a moral influence on the conduct of the army; but the order of the Bath, as at present constituted, may be considered in a different light.

Before the year 1815, the number of distinctions awarded to officers for meritorious actions was very small; and none had been allotted to soldiers. The government availed itself of the extraordinary successes during the campaign of "the hundred days," to give to the ancient order of the Bath somewhat the appearance of a new institution. This order, claiming an origin as remote as the year 1399, is, like the Legion of Honor, at once civil and military. It is composed of three classes only, grand crosses, commanders, and companions. Since the year 1816, this order has consisted of 68 military knights grand crosses, and 12 civil, 196 knights commanders, and 520 companions.

It may be seen by these details, that the English government has been much more sparing of military distinction than other European powers. The British ministry acts under the eyes of an enlightened and prudent legislature; it is watched in all its innovations by a people jealous of their liberties, and particularly ready to take alarm at whatever tends to give the mi-

litary too great an influence. But even should the English people, blinded with regard to their true interests, behold with indifference a prodigal distribution of honorary rewards, each of which serves to increase the distance between the soldier and the citizen, I doubt whether, even in this case, the English government would so far debase the value of its gifts, as indiscriminately to load its servants with a thousand decorations, much less to degrade an illustrious order by squandering away those honorary distinctions, which are so incentive to great deeds when exclusively the reward of merit.

Properly speaking, the English, previous to the close of the year 1815, had no military order which officers of various ranks might hope to obtain, however great their devotion and heroism. When a government only distributes its honorary rewards amongst forty or fifty dignitaries, these distinctions may become a great object of emulation with some generals, but they do not afford any reasonable prospect for the hopes of other officers. The English army and navy had already, however, achieved their most memorable exploits, previous to the new organization of the order of the Bath; and general bravery, not less than personal devotion, was, in these two bodies, never found wanting at an important juncture. The new order of the Bath, then, should

be considered as an institution dictated by gratitude or vanity. Perhaps, indeed, it may have been inspired by views more dangerous, but certainly not from the necessity of giving a stimulus to the valor of the army.

Among the ancients, rewards given for brilliant actions were purely personal, and always so appropriate, as by their very nature to point out the species of service which they were intended to recall.—At Rome, for instance, an oaken crown, being the most honored,* was destined for the warrior who preserved the life, whether of the least or of the greatest, of his companions in arms; a castellated crown of gold was granted to him who mounted first to the assault of a fortified place or camp; olive, laurel, or golden crowns, in imitation of the foliage of these plants, were bestowed on generals who were successful in single combat, or who obtained a signal victory; a naval crown was

* The civic crown entitled the wearer to the most valuable privileges. We shall quote on this subject one of the finest passages in Pliny, Hist. Natural. lib. xvi. § 5. "Acceptâ licet uti perpetuo, ludos ineunti semper assurgi, etiam ab senatu, in more est. Sedendi jus in proximo senatui. Vacatio munerum omnium ipsi, patrique et avo paterno. O mores æternos qui tanta opera honore solo donaverint: et cum reliquas coronas auro commendarent, salutem civis in pretio esse noluerint! Clarâ professione, servari quidem hominem nefas esse lucri causâ.—*Author*.

the reward of actions at sea, &c. In a military point of view, a very great advantage resulted from that appropriate application of different honors to different actions; and, under a free government, no citizen could obtain these distinctions through favor or interest, if he had done nothing to deserve them, nor, if he had, could they be withheld from him.*

In a political point of view, warriors undistinguished by signs, titles, or general appellations, do not form a privileged body in the state; and, consequently, are not likely to imbibe the spirit of an aristocracy, the more dangerous from the popularity and influence which it would acquire by the reputation of valor and military genius.

The soldiers and under-officers of the English

* When Napoleon returned from the island of Elba, his first care was to annul all the appointments to the Legion of Honor made after his abdication; and this act was not unpopular, because these honorary distinctions had been prodigally distributed. If they had only been given for certain actions, and in a way declarative of the nature of such actions, this despotic measure would only have seemed the height of folly, or, probably, it would never have been attempted. Further, it is evident that, notwithstanding the illegality of the titles obtained under the government of "the hundred days" in the eyes of the royal administration, the king could not have cancelled them if they had only been, like the rewards of the ancients, a solemn attestation of services recognized and fixed by law.—*Author.*

army are excluded from participation in the honors of the military orders. The only mark of distinction which the serjeants can obtain, is the badge of the colors placed on the right arm: but, by a measure which robs the honor of its value, this distinguished badge acquired by services, can be taken away from the under-officer simply at the decision and arbitrary will of the commanding officer of the corps.

All the English soldiers who were present at the battle of Waterloo wear a silver medal, suspended by a red ribband. This is in imitation of the distinctions awarded by the Spaniards and Germans, and appears to be the copy of an original which, in itself, is not happily conceived. Nothing is more just, or better adapted to keep alive in the army that sentiment of honor and love of true glory, which make men undergo all privations, endure every ill, and brave every peril, than that a mark of distinction, commemorative of a noble deed, a feat in arms, or a trait of extraordinary devotion, should be bestowed on the soldier and under-officer who distinguish themselves in the field of battle. But to grant to fifty, sixty, or a hundred thousand men the same distinction, for having been together on the same day, and on the same field of battle, where certain corps alone shall have decided the event of the action

by their valor and exertions, whilst others, on the contrary, have rendered it doubtful by their ignorance or their inactivity: to recompense equally, I say, in every corps, the hero whose ardor has animated his companions, and the poltroon who, trembling with impatience to shun the danger, has only been prevented from quitting his ranks by the fear of immediate punishment, is the height of folly.

I believe the English ministry to be too enlightened not to have foreseen the inefficacy of indiscriminately bestowing the same rewards for different actions: their object has rather been to decorate a large body of soldiers with an ornament commemorative of the victory of Waterloo under the administration of 1815. The ministers have thus found the means of flattering, at once, the national pride, and their personal vanity. But they have not been able to form an institution that should act upon the moral energies of the army.

Military Punishments.

The punishments of the English soldier have always held a peculiar character of ferocity. The criminal underwent capital punishment by decapitation, by hanging, and sometimes even by drowning, according to the nature of the offence, and the rank of the condemned.

In 1189, when the crusaders of England departed for the Holy Land, Richard the First decreed, that any crusader, who, during the passage, killed a man on board ship, should be tied to the dead body and thrown into the sea; that any crusader killing another on shore, should be interred alive with the dead body of the man slain; that every crusader wounding another, should lose his hand. Every thief was shaved, and his head then covered with long feathers, and upon these was poured boiling pitch, from which they could not be torn without severing the skin from the head. In this state he remained exposed to the view of the army, and was afterwards landed on the first shore at which the fleet touched, &c.

Commonly, when crimes were committed by a body of troops too numerous to admit of all the delinquents being punished, they were decimated. Upon such occasions, it was usual to assemble the army in order of battle, and to lead forth the first, the eleventh, the twenty-first, and every tenth man in succession, to immediate punishment. This left nothing to chance, but was simply condemning men of certain files to an arbitrary death, to expiate the misbehavior of the whole body. At other times recourse was had to the award of chance. The soldiers, whom it was in agitation to de-

cimate, were made to throw the dice that determined their fate upon a drum head. Each threw in his turn; the numbers thrown were, with the names of the throwers, inserted in a list by the provost marshal. The smallest numbers pointed out the men who were to be conducted to execution. Will it be credited, that at the period of the revolution occasioned by the accession of William the Third to the throne of England, this mode was still in practice in Ireland?

At present, the only capital punishments to which English soldiers are liable, are those of shooting and hanging. Care is taken after every execution, to make the troops defile before the body, and, above all, the recruits, who are obliged to pass one by one close to the corpse.

Mutilation was a punishment formerly much resorted to; and for this reason, the mutiny act carefully specifies the courts-martial, whose authority may or may not extend to loss of life or limb. In certain cases the hand, and in others, the ears, of the condemned, were cut off. By the frequency of these barbarous punishments, not only for military, but for political offences, the Stuarts* much increased the people's hatred

* The refinement of barbarity was carried so far, as to make the prisoner lose one of his ears in one public place, and the other ear at a second; affording the double advantage of pro-

of their dynasty. Mutilation is now abolished, death being the only punishment awarded for heinous crimes; and corporal punishment, more or less severe, for minor offences. The soldier who deserts, rebels, &c. is shot to death; the spy is hanged: the remaining punishments consist in the drill, in confinement, in the cat-o'-nine tails, and in branding. The cavalry and artillery formerly made use of the punishment of the picket: the delinquent was fastened by the wrist to a place sufficiently high to allow of one of his feet resting naked on the point of the picket, thrust into the ground. The prisoner had, thus, only the choice of the torture occasioned by the forced distention of the muscles of the arm, or that produced by the pressure of the whole of the body upon a point which bore against the nerves of an extremely sensitive part. This punishment, which seems to have been taken from the tortures of the inquisition in Spain, having maimed a number of soldiers, was finally abandoned; and that also of the gauntlet is now no longer in use. When a soldier was condemned to run the gauntlet, the regiment was formed in line, and the ranks were opened. Every soldier being provided with a switch, the

longing the punishment, and of parading the unfortunate sufferer through the city, covered with blood, and followed by an immense concourse of populace.—*Author.*

culprit, naked down to the waist, passed between the ranks, whilst a serjeant with a bare halberd to his (the culprit's) breast, preceded him at a regulated pace, and prevented him from hastening his steps, to diminish the number of lashes which he received upon his back and shoulders.

Care has been taken to retain the punishment of the lash; and, as it is that of all others most opposite to our customs and manners, it chiefly merits our attention. I acknowledge I cannot conceive the necessity of punishing the English soldier by a flagellation equal to the schlag of the Prussian or Austrian, and the knout of the Russian. This barbarous chastisement is unworthy of a free people; but we must not, therefore, imagine that military spirit is debased, and bravery extinguished or diminished, by such a punishment, when public opinion does not attach dishonor to it. The Roman soldiers were beaten with vine twigs; and yet no one will ever dispute that they possessed valor in the highest degree. But when the manners of a people are particularly ferocious, it is not surprising that their discipline should bear the same stamp. Nothing can be more honorable for the French army, than its being the only one in all Europe that could never be brought to submit to this punishment, so degrading to man.

In England, its infliction is preceded by remarkable preparations.

When a soldier is condemned to the lash, three serjeants' halberds are planted into the ground, and the steel points of these are fastened together with a cord, which serves, at the same time, to bind the prisoner's wrists above his head. The three halberds thus placed, resemble the three edges of a triangular pyramid uniting at the vertex, and are generally known in England by the name of *the triangles*. Across two of the halberds already erected, a fourth is fastened horizontally as high as the prisoner's waist, against which he leans, his feet being attached to the two halberds just mentioned.

In this constrained position, the prisoner, being stripped, is beaten on the back and shoulders, or on the back, according to the nature of his offence, with a whip of nine tails, each tail having nine knots. For this reason it has acquired the name of *cat o' nine tails*. Under the direction of the drum-major, the drummers of the regiment successively inflict five-and-twenty lashes; and the adjutant is always present to enforce the exact and vigorous execution of the prescribed number of lashes. Lastly, the surgeon, or his assistant, must be present during the infliction of the punishment, in order that the prisoner may not be flogged so as to en-

danger his life. When it is found necessary to discontinue the punishment, before the prisoner has received the assigned number of lashes, he is taken down and conveyed to the hospital, where he remains until he is sufficiently recovered to undergo the remainder.

Who would believe that so dreadful a punishment could be inflicted for the slightest military crimes, and often even to suppress by terror the just demands of the soldier? The following is what a military writer well versed in details of the management of corps in the English army has declared on this subject: "I shall leave the reader to draw his own conclusions, with the observation, however, which I already made in the body of my work, that there have been more flagellations occasioned by the mysterious manner of equipment, and sometimes, (as in the following example) by avowed fraud exercised on the soldier, than by want of discipline or good conduct." *Regimental Companion*, Preface, page 45. "For my part," says the same author, "with regard to the supply of, and charge for necessaries, I firmly believe that if the captains, under the eye of superior officers, were more exact in the inspection of necessaries, not one soldier in a thousand would ever have to undergo the punishment of flog-

ging."* When a corps is on its march, and it is wished to inflict an immediate punishment of this nature, the troops are halted, the officers are assembled about a drum, which forms the desk of this itinerant tribunal. The simple negative† or affirmative of this court acquits or condemns the prisoner arraigned; in the latter case the sentence is carried into effect without delay, and afterwards the corps continues its march. This species of judicature is called *drum-head trial.*

The walls of the British parliament have often re-echoed with the generous voice of opposition against the barbarity of corporal punishment. Sir Francis Burdett has long distin-

* Many years ago, there may have been truth in these statements: but we appeal to every officer in the service, whether they have the slightest foundation as applied to the present time. The *mysterious manner* of equipment in necessaries is assuredly not among the grievances of the soldier of this day, nor the cause of any portion of the corporal punishment which is inflicted as the system is now carried on.—*Tr.*

† The members of a drum-head court-martial are regularly sworn, in the same manner as those of a less summary military tribunal; and this mode of trial differs only from the usual regimental court-martial, in the circumstance that its proceedings are not committed to writing. It is never resorted to but on occasions where an instantaneous and striking example is imperiously demanded.—*Tr.*

guished himself among the orators who have defended this cause so dear to humanity; but his efforts have not hitherto been attended with success. Whilst speaking on the subject of corporal punishment, Sir Robert Wilson took occasion to protest against the cruelty of the English discipline, and its bad consequences. "The Duke of York," said he, "has already mitigated some of the punishments, and the humanity of his measures has produced the happiest effects. In the Duke of Gloucester's regiment, it was thought necessary, for the maintenance of good order by an inexorable discipline, to have frequent recourse to corporal punishments; but it appeared as if that very frequency multiplied the crimes of the soldier. This prince has put an end to these infamous punishments, and his regiment, by its conduct, has become an example to the army."

A general officer of the British army declared however, that he did not believe good discipline could be upheld among the troops without the use of flagellation. But did not the Spartans formerly say as much of the Helots; the colonists of the negroes, and the nobles of their slaves? At the conclusion of this discussion, parliament without the slightest hesi-

tation confirmed, as it does annually, the use of corporal punishment.*

* The necessity of corporal punishment in the British army is a question which has been so repeatedly discussed, and so strongly confirmed by the testimony of the great majority of experienced military men, that any notice of the subject in this place would be superfluous, but that silence might be misconstrued into an acknowledgment of the justice of the author's conclusions. Without the slightest *personal* knowledge of the peculiar character of our soldiery, and upon the hearsay and report of a few months' residence in England, he has at once decided upon the useless cruelty of our military code; and, in opposing his judgment to the practical opinions of the first officers in our service, seems to have entertained no suspicion that he might be wrong. But it is not by analogy with the military system of other countries that we can reason correctly on this point. Among the British soldiery, unlike those of continental armies, the commission of heinous crime is nearly unknown. Drunkenness is almost their only vice, but it is one to which they are lamentably addicted, and no watchfulness, no severity of discipline has power entirely to eradicate it. It is a melancholy truth that nothing but the dread of the lash can at all restrain the soldier from excess in the use of liquor; and those commanding officers, who have with most justice prided themselves upon the practice of an able system of prevention of crime, have found their best efforts baffled by the inveterate attachment of their men to this species of debauchery. It is well known among military men that nine corporal punishments in ten are occasioned, immediately, or indirectly, by this single blemish in the fair character of our soldiers. If, then, the terror of the lash, aided by every preventive care, can with such difficulty curb this unfortunate passion for intoxication, how would it be proposed to keep it

within bounds if the only powerful check were removed? An universal system of solitary confinement would be in most situations utterly unattainable; and the only remaining expedient, of taking life less scrupulously in exchange for the abolition of corporal punishment, would surely be granting nothing to the cause of humanity. In the French service, where drunkenness is rare, and crime of a deeper cast more frequent, such a code, knowing no intermediate degree between the slightest and most severe of punishments, between death and confinement to a guard-room, may be found well calculated for its object, but it would be wholly inapplicable to the case of the British soldier.

While, however, we are reluctantly compelled to admit the impracticability of any attempt to abolish corporal punishment altogether, without the consequent destruction of discipline, it cannot be doubted, that its frequency may be (as it has been) very materially diminished by proper attention to the means of preventing crime, and by subjecting the proceedings of regimental courts-martial, as well as the whole interior economy of corps, to the periodical inspection and constant surveillance of general officers. In these respects, it is impossible to speak too highly of the judicious measures which have emanated from authority within the last fifteen years. A commanding officer is now made to feel, that the character of his corps and his own reputation are equally affected by the degree in which he is found to resort to corporal punishment for the maintenance of discipline.—*Tr.*

CHAPTER III.

Interior Discipline of Corps; Effects of this Discipline upon the relations between the Soldier and the Citizen.

The discipline of the English army is worthy of the most profound examination; it presents means and results which seem in some instances to have reached the utmost possible good, and in others, the greatest possible evil. We have already seen to what a degree of severity corporal punishments are carried; but there fortunately are other means, besides chastisement, to bring men to obedience, and to induce them to fulfil all military duties; and the English have turned some of these means to a happy account. To consider this subject in all its most important points, we shall enter, first, upon the interior discipline of the army, and afterwards, upon the effects of this discipline with respect to the relations between the soldier and the citizen.

There does not exist, perhaps, any army in Europe, in which the distinction of rank is so strongly marked as among the British troops. With these, the distance, which separates the soldier from the simple corporal, is immense; that, which divides the corporal from the ser-

jeant, is yet greater; and finally, the officers appear to form a class of beings of a different nature from that of the under-officers, with whom the former never admit of the slightest familiarity. One of the least apparent, but, nevertheless, greatest improvements in the organization of the English army, is the difference in the pay of the under-officers and soldiers. If an under-officer has the means of subsisting decently, he will never have recourse to meanness, or base compliance towards those of a subordinate station in order to obtain a repast or a present: he will be less tempted to defraud them, or at least he will be more inexcusable, and his degradation from an honorable and happy station will render him a much more forcible example to his companions in arms. A soldier is liable, at the mercy* of his superiors, to receive the most cruel and ignominious punishments. But an under-officer, being considered as an officer, although without a commission, cannot be condemned to corporal

* This is incorrectly asserted: for the soldier is punished by the judgment of the same tribunal whose decision may reduce a non-commissioned officer to the ranks, and even superadd the infliction of corporal punishment to such degradation. The soldier cannot be brought to the halberds at the mercy of a commanding-officer, before he has been regularly condemned by a court-martial.—*Tr.*

punishment. It is necessary he should be solemnly degraded, before, if occasion require it, he can be punished as a private soldier. The under-officer, then, as long as he retains his station, has all the superiority of rights over the soldier, which the free man formerly enjoyed in the feudal army over the slave and the peasant; and whilst the soldier often discovers all the vices of the slave, the under-officer preserves all the dignity of a free man. The under-officers of the English army are generally remarkable, as a body, for the respectability of their demeanor, the martial severity of their appearance, and the authority of their command. This chosen body unite experience and good conduct, intelligence and dignity: and, to complete the eulogium, whatever obedience and respect they exact from the soldier, they offer an example of in their own deportment towards officers of all ranks. To impress on the mind of an inferior a salutary deference towards his superior, the former is taught, from the first moment of his entrance into the service, to salute the latter with a formality which may, at first, seem puerile, but, after mature deliberation, will be found worthy of imitation. The instructor forms all the recruits in rank entire, some paces from him. At his command, each of them, in succession, marches past him,

extends the arm farthest from the instructor, to raise it to the height of the shoulder, and looking at him in a respectful and soldier-like manner, gradually brings the hand round to the peak of his cap, the fingers being horizontally extended, and the palm downwards. The soldier, after he has passed, withdraws his arm, much in the same manner as he saluted, and lets it fall into its natural position.

The general regulations of the English army on the subject of the salute, observe: "Officers commanding brigades and regiments are held responsible that the most scrupulous attention is paid to this very essential point of discipline. No neglect of this duty should, in any case, escape reprimand or punishment, according to the circumstances of such want of respect."

In France, a soldier scarcely ever salutes any officers but those of his own regiment. Sometimes, however, a soldier of the line bestows a sort of half salute on officers of the artillery or engineers; but a trooper, a sapper, or an artillery-man, would think it derogatory to the dignity of his branch of the profession to salute an officer of any other corps but his own. If a French trooper should not be distinguished by his uniform, he would be recognized among a thousand by the air of disdain which he affects at the sight of a foot soldier. Certainly,

this want of mutual respect does not necessarily produce insubordination, but it is a sure indication of an imperfect spirit of discipline. This subject is not unworthy of consideration by our most distinguished officers. It would be wrong to imagine that, in the English army, obedience and respect are only imposed by terror, and shown merely by marks of deference exacted by authority. If there are chiefs of corps and other officers who conduct themselves with harshness, haughtiness, and cruelty, and regard the soldier as an intelligent machine, or brute, destined simply to be the instrument of their ambition, the toy of their vanity, and the sport of their passions: there are, on the other hand, commanders who do honor to the human character, by the goodness of their hearts, and the generosity of their conduct towards the troops under their authority.

A lieutenant-colonel, (whose name I regret not having it in my power to engrave on the memory of all admirers of military virtue,) who commanded a regiment in the West Indies, lately afforded one of the finest examples of generosity of character that history has on record. The yellow-fever made such ravages in the colony where he was stationed, that, all the hospital attendants having perished, it was found necessary to replace them by soldiers.

But the half of those destined for this perilous office were immediately seized with the malady, and the rest refused to continue the performance of duties which only seemed to ensure them an inevitable death. "It devolves then upon me," said the lieutenant-colonel, "to take care of my own soldiers, since their brothers in arms refuse to fulfil this duty." This generous officer devoted himself to employments, in themselves mean and disgusting, but ennobled by his motives, and hallowed by the object which he had in view. This hero of humanity, who deserved to live to receive the tribute of public admiration, unfortunately fell a victim to the disease, the virulent effects of which among the soldiers he succeeded in arresting. The English parliament should erect a national monument in Westminster Abbey, worthy of perpetuating the remembrance of this noble deed.

If the English confined themselves to employing all the means that knowledge of the human heart, and the best feelings of benevolence can dictate, to bind the different ranks of the army by the reciprocal relations of punctual obedience and defined command, of respect on the one hand, and humane consideration on the other, the British army would merit being held forth as an example to all civilized nations.

Let us hasten to show how much has been done by the British government in this respect. In Great Britain the supreme authorities employ great care to ascertain the character and instruction of the troops. General officers, on active service, are enjoined to send half-yearly, at the beginning of the months of May and October, a confidential report upon the discipline of the corps, and upon the merit of the officers placed under their immediate orders. This report, sent to the general commanding the district, station, or the army, (as it may be) and accompanied by the observations of this officer, is transmitted to the adjutant-general, to be laid before the commander-in-chief. These communications make particular mention of the officer commanding every regiment or battalion since the last confidential report; of the degree of attention and care this officer has bestowed on the different branches of the service; of the progress, whether sufficient or not, which the corps has made in its interior discipline, its military exercises, and in the manœuvres prescribed by the regulations; and further, of the officers, who, whether by age, infirmity, other accidental causes, or by their misconduct, appear unfit for the service.

These confidential reports must also signify, if proper care has been bestowed by the com-

mandants of corps, field-officers, and captains, on the instruction of the subaltern officers; if these last are zealous, intelligent, and well-informed; if they are active, obedient, and respectful towards their superiors, and if they cause their authority to be properly respected: whether the captains are well versed in the economical details, and in the command of their companies; whether the adjutant, quarter-master, and paymaster are fully equal to the performance of their duties; if their books are kept with care, exactness, and regularity: whether the officers of every rank support the commanding officer as their duty and situation require; whether unanimity and good understanding prevail among the officers; if they mess* together, and with an economy suitable to the subalterns.

When an officer is incapable of fulfilling his duties, a report must be made of his particular incapacity, in order that his promotion may be suspended; and, in case of continued disability, that he may be removed from the service. The confidential reports must speak, with equal exactness, of the under-officers as of the officers;

* The constant custom prescribed to commanders of corps of messing with officers of every rank, and of maintaining decency and harmony in the midst of a body subordinate to them, must be considered as very paternal.—*Author.*

of their instruction, their intelligence, and their obedience; of the respect which they show to their superiors, and of that which they exact from the soldiers. Inspecting officers are desired to ascertain, by personal examination, the general state of health among the soldiers, their sobriety, their conduct, and their instruction, &c.; they must inform themselves of their grievances, and of the motives of their complaints, &c.

But it is in the relations between the soldier and the citizen, that the British army deserves to be named as a model for all nations, who cherish both law and liberty. The British government has discovered the secret of constituting an army, formidable alone to foreign nations, and which considers obedience to the civil authority of the country as a part of its glory.

I admire the answer of an English soldier, in the midst of an assembled populace, whom he had joined in demanding from the government a measure ardently desired. "Well, friend, (said one of the crowd) you will not take up arms against us, surely? and we may regard you as one of us." "At present, (answered he,) I am a citizen, and reclaim my rights as such; but, under arms, I shall be a soldier, and shall execute the orders I receive to compel you, if it be necessary, to

obey the law." This is the spirit that animates the British army.

These noble sentiments are imprinted on the countenance of the British soldier. He has not that menacing and ferocious aspect which, on the European continent, is too often taken for martial appearance. He does not insolently scrutinize all who pass, both men and women, with an arrogance which seems to say: "I am the personification of power and the object of terror," &c.

In England, such an air does not excite admiration; and the imitation of a braggadocio never becomes so frequent as to give rise to the caricature of a *calicot*, which would be only laughable, if it did not originate in a deplorable state of society. With very opposite feelings to those prevalent on the banks of the Thames, the clerks of counting-houses and offices in France, equip themselves in high heels, spurs, and mustachios, to ape the martial figure for an hour: but a military man rather endeavours, on leaving the camp for the city, to lay aside his professional character. Whenever an English officer arrives in the capital, far from appearing to be in the service, he throws aside his arms, uniform, and decorations; his dress does not differ then more from that of a common citizen, than the plain coat, whether of a

member of Parliament, or of a prince of the blood.

I dwell particularly upon this custom, which will be gradually introduced amongst us, in proportion to the growth and maturity of public liberty. Hence it is, that the officer, constantly returning into the class of citizens, assumes its spirit and character. Hence, also, the people are accustomed to look upon the military as citizens, temporarily armed for their defence, but not attached to the sword as a janizary to the scimitar, and devoted to war, to the exclusion of every other duty. Such should be, on this subject, the spirit of a people governed by constitutional laws.

The English soldier is obliged to be constantly in uniform; but, whilst on the home service, and particularly in time of peace, he is not armed, unless on duty. In this last case even, if in consequence of a dispute with the citizens, the soldier abuses the means of aggression which he possesses, by striking any of them, a cry of horror is raised on all sides, and the vengeance of the law falls upon the offender with unmitigated rigour. We must add, however, that, in every case of this nature, the soldier would be tried *by the civil courts.*

In England the corporal and private soldier of the infantry do not carry the sabre; because

the musket with the bayonet simply considered as a manual weapon, is much more formidable than the sabre, both for attack and defence. The officer and serjeant are alone permitted to wear the sabre or sword; they are not armed, but when on duty or on the parade. The serjeant has generally so strong a sense of propriety, that there is hardly an instance on record of his perverting the use of his arms to spill the blood of defenceless citizens. Even when the English troops are under arms, nothing changes their regard, indeed I may almost say respect, for the humblest of the citizens; and I have seen companies marching in file on the foot-path move towards the middle of the street, to give place to the inhabitants coming in an opposite direction. Sentinels are never seen performing in England, as on the continent, the duties of a police worthy of Algiers or Tunis, by announcing, with the butend of their muskets, and sometimes even with a thrust of the bayonet, that *nobody can pass there*, or, *nobody must stand here*. Even when, in the extreme cases of rebellion, or breach of public peace, an armed force is required to assist the civil power, the troops still respect the citizens, at a moment when these last cease to respect themselves. Led by the civil officers, they march to the scene of tumult, and are drawn

up in sight of the insurgents, from whom they endure every species of insult, and even vollies of missiles. The magistrate must read the Riot Act to the seditious multitude, and enjoin them, according to the act, peaceably to disperse; and give them an entire hour to submit to the authority of the law. It is only at the expiration of this period that he commands, if it be indispensable, the tumult to be quelled by force.

Notwithstanding the declamation of demagogues, and of the pretended radical reformers, who seek to overturn the constitution, the citizens, most jealous of their liberty, do not fear the English army, as it is at present organized. The officers possessing most influence, the most celebrated generals, however great their services, or glorious their victories, are not more dangerous to liberty than the most obscure zealots. The nation, with a wisdom worthy of imitation, loads its victorious chiefs with rewards, honors, and dignities; but does not extend their rights beyond those of the humblest citizen; and only places them among the most distinguished of its leading men. This has been very well understood by the author of the *Considérations sur la Révolution Française*.

But Madame de Staël was very much deceived as to the discipline of the British troops, serving in foreign countries. In this respect I cannot participate in the enthusiasm which

she expresses. The discretion and moderation that distinguished the conduct of the English officer and soldier in France are not, in my opinion, by any means ascribable to the natural effects of the constitution and moral tone of England. Or else, why should troops, so prudent and moderate amongst us, have been much less so with the Portugueze and Spaniards? Why so much discipline among an hostile people, and so little with friendly nations? . . . . . . I could dwell on such a subject, and produce numerous, authentic, and indisputable facts in answer to these questions.* But I am unwilling that this work should be

* We have little reason to feel indebted to the moderation of the author, in suppressing his "numerous, authentic, and indisputable facts," of the misconduct of our troops towards the inhabitants of the Peninsula, while his insinuations have left the reader to imagine every variety of rapine and violence, as the sufferings inflicted upon our allies by the British soldiery. Had he produced his evidence, there would have been little difficulty in disproving the charge; but, as he has not chosen to do so, it may be sufficient to observe, that the strictest discipline was enforced in the Peninsular army, for the protection from outrage of the peaceable inhabitants of the country, that acts of violence on the part of our soldiery were extremely rare, and that, when they did occur, they were punished with exemplary severity. In no instance was the slightest licence allowed to the soldier, except in cases where, with all troops, and under all circumstances of warfare, it is impossible wholly to avoid it —in the assault of open breaches. Even then, order was restored at the first practicable moment.—*Tr.*

reproached as an odious collection of all that could tend to lessen the British people in the esteem of other nations, and to rekindle that hatred which, I should wish, on the contrary, to see for ever extinguished. Here, then, let us conclude our inquiry into the moral energies of the British army.

BOOK VIII.

OF THE MILITARY SCHOOLS.

CHAPTER I.

Of Regimental Schools;—Royal Military Asylum.

During the last wars, the surprising activity of industry and commerce offered employment of the most advantageous description for the talents of every man who could merely read and write. On the other hand, notwithstanding the high bounties offered for enlistment, the prospect was so little flattering to a recruit, that the government, in their military levies, could hope to obtain nothing but the refuse and most ignorant portion of society. Among the English soldiery, therefore, it was rare to meet with men who had acquired sufficient acquaintance with the first elements of instruction, to enable them to exercise the slightest military functions. Such information was yet more unfrequent in recruits drawn from Ireland; and it was in Scotland only that a sufficient number of men could be obtained by some of the regi-

ments, with the power, from the general extension of education throughout that country, of drawing up a return, or calculating an account. Among the non-commissioned officers of the army, the proportion of Scotch to English, and more particularly to Irish, was constantly much greater than that between the soldiers of the same countries. We may further observe, also, that the natural pride of the Scotchman, his prudence, and sobriety, render him singularly fitted to fill the lowest degrees of military authority; stations in which, from the slight degree of elevation above inferiors, every sentiment of personal dignity, and knowledge of the limits beyond which his power cannot be exerted, are necessary on the part of the non-commissioned officer, to preserve the respect, without exciting the fears and consequent hatred of the soldier.

To afford the courage, and particularly the good conduct of the soldier, more chance of reward, by placing a considerable number of the children of the troops in a situation to become non-commissioned officers, the British government has founded regimental schools. In a work, by Captain Edward Stirling, entitled, "Views of Military Reform," it is stated that the late Duke of Kent was the first who, in his regiment, (the Royal Scots) realized the idea of

forming a school, for the instruction of young soldiers and children of the troops. This was effected much about the period when Joseph Lancaster, having settled near London, succeeded in placing his systematic school of mutual instruction in a flourishing condition, and the Duke adopted his plan in the regiment. A serjeant, instructed by Lancaster, became the master of the school of the corps, and some time afterwards, when the Royal Scots returned to be quartered in their own country, twelve children of the regiment were brought by their master to Edinburgh, and there publicly examined by Lancaster himself, before the University, the magistrates, and eighteen hundred of the inhabitants, whose presence marked the interest felt by the Scotch in the progress of the humblest as well as the most dignified branches of information. When the regiment were afterwards stationed at Stirling, the magistrates offered the great room of their town-hall for the seat of the school, with the simple understanding that the children of the citizens should be admitted to share in the instruction afforded to the young soldiers.*

* The following account is given of the success of this school by Lancaster :—" The lieutenant-colonel of the Royal Scots has recently communicated to me the happy and rapid progress of regimental schools ; he declares that the complement of in-

The English church could not see with indifference a dissenter, a quaker, actuated by the sole motive of philanthropy, disseminating with rapidity a mode of instruction, wherein the established religion did not exercise its intellectual monopoly, and into which it could not infuse its privileged doctrines. Fortunately, an English minister, Doctor Bell, threw himself into the arena with *his* special method, and appeared to hold out to the church the prospect of a plan of instruction more favorable to the maintenance of its prerogatives. Accordingly, therefore, when the government determined upon establishing schools in all the regiments, it was the method of Doctor Bell which was employed, and substituted for that of Lancaster, in many regiments which had already adopted the latter.

"Already," said Lancaster in the month of May, 1811, "near eight hundred youths have been successively taught in the school of the Royal Scots, in the two years during which it has existed. As it is established at the depôt

struction given by this means to the non-commissioned officers, is equally useful and admirable." He considers the institution as a *wholesale manufactory* of non-commissioned officers; and strongly recommends the choice of the best of the students for serjeant-scholars, as an excellent mode of emulation, and a nursery for non-commissioned officers.—*Author.*

battalion, new scholars are continually received, and put into condition to pass, as non-commissioned officers, into the battalions on service," &c. The Duke of Kent made present of a silver medal to every subject formed by the system of mutual instruction. There is a satisfaction in recording such enlightened traits of benevolence, for they form the true glory of princes.

On the 14th of November, 1811, the Duke of York, the commmander-in-chief of the British forces, apprized the heads of corps that the government intended to establish regimental schools for the education and instruction of the children of non-commissioned officers and soldiers; that a master must be chosen for each corps, with the rank and pay of serjeant; and lastly, that the object of these schools was to implant in the minds of the children early habits of morality, obedience, and industry, and to give them sufficient information to qualify them for becoming non-commissioned officers. To realize this project, the commander-in-chief caused to appear, on the 1st of January, 1812, a general order, which we shall give literally, to exhibit the views and cares of government in founding the institution in question.

"With a most earnest desire to give the fullest effect to the benevolent intentions of government, in favor of the soldiers' children, to

which His Royal Highness the Prince Regent has, in the name and on the behalf of His Majesty, given the royal sanction, the commander-in-chief calls on all general officers, colonels of regiments, and commanding officers of corps, to take under their special superintendance the regimental schools belonging to their respective commands; and His Royal Highness is persuaded, that, bearing in mind the important benefits which these institutions, under proper guidance and management, are calculated to produce to the individuals themselves, to the army, and to the nation in general, they will consider them as deserving their constant personal care and attention." "It will rest with the children themselves, when arrived at a proper age, to adopt the line of life to which they give the preference; but it is extremely essential that their minds should be impressed with early habits of order, regularity, and discipline, derived from a well-grounded respect and veneration for the established religion of the country. With this in view, the commander-in-chief directs that the regimental schools shall be conducted on military principles; and that, as far as circumstances will permit, their establishment shall be assimilated to that of a regiment, and formed on a system invented by the Rev. Dr. Bell, which has been adopted with the

most complete success at the Royal Military Asylum."

"His Royal Highness has directed, that extracts should be made from Dr. Bell's 'Instructions for conducting a School, through the Agency of the Scholars themselves,' which have received Dr. Bell's approbation, as the best directions His Royal Highness can give for the conduct of the regimental schools of the British army."

"It is necessary to observe that, although in the instructions boys only are mentioned, yet the female children of the soldiery are also intended to partake of the benefits of this system of education, whenever the accommodations, and other circumstances, will permit. The commander-in-chief considers it peculiarly incumbent on the chaplains, and other clergymen engaged in the clerical duties of the army, to give their aid and assistance to the military officers in promoting the success of these institutions, by frequently visiting the regimental schools of their divisions and garrisons; by diligently scrutinizing the conduct of the serjeant schoolmasters; examining the progress and general behavior of the children; and reporting the result of their observations to the commanding-officer of the regiment."

"It must ever be remembered, that the main purposes for which the regimental schools are

established, are to give to the soldiers the comfort of being assured, that the education and welfare of their children are objects of their sovereign's paternal solicitude; and to raise from their offspring a succession of loyal subjects, brave soldiers, and good Christians."

The exertions of the commander-in-chief did not end with the issue of this general order. He prescribed to general officers commanding districts at home, as well as on foreign stations, to transmit to him regularly, and for each corps, reports, showing the number of scholars of both sexes in the regimental school, together with the opinion of the general officer, and that of the chaplain, upon the talents and conduct of the serjeant-schoolmaster, and of the progress made by his pupils. In 1815 the Duke of York, with the noblest of motives, called the attention of commanding officers of corps to the necessity of affording the children of soldiers such manual instruction as might render them useful, and enable them to earn a livelihood.—" This, (said he) may be effected at very little expense, by employing the best-conducted and clever, among the women of the regiment, in teaching the girls to sew and knit stockings; and the tailors, and boot and shoemakers, in instructing the boys in their respective trades. By these means, all the children may be early made use-

ful, and become capable of procuring a subsistence. The commander-in-chief is persuaded that, by applying with economy the funds left at the disposal of commanding-officers of corps, and making suitable arrangements for the sale of the produce of the work, it will be possible to execute this project without any additional expense."

We pass from the regimental schools, to the Royal Military Asylum, which was founded by a warrant, bearing date in 1801: it is a school destined for the reception of the orphan and other children, of non-commissioned officers and soldiers; and is situated at Chelsea, near the hospital for invalids, in extensive grounds, on which all the buildings necessary for the establishment were erected for the purpose. In 1803 the school was opened, with the original intention of receiving only seven hundred boys, and three hundred girls; but these numbers have since been increased. Although it had been reduced after the peace, yet when I visited the establishment (in August, 1819) there were still eight hundred and fifty boys, and four hundred girls; besides four hundred boys educating at an additional branch of the institution at Southampton, upon the same principles, and after exactly the same plan, as those at Chelsea.

The building at the latter place is composed of a large central edifice, and of two wings connected with it by colonnades. In front of the main edifice is a portico of considerable size; with four Doric columns of grand dimensions, and of fine white Portland stone. The entablature and cornice, supported by these columns, accord with the same ornaments which crown the second and last story of the building. The portico is surmounted by a triangular pediment, on the centre of which are sculptured the arms of Great Britain, with this inscription:

ROYAL MILITARY ASYLUM
FOR THE CHILDREN OF SOLDIERS OF THE REGULAR ARMY.

The large portico is the sole ornament of architecture which decorates the military asylum, and perhaps even that is too much. With no greater cost than for its erection, a much more considerable depth might have been given to the colonnades, where the children take their recreation in summer, during excessive heats, and in other seasons, when either rain or extreme cold renders the open air insupportable.

On the ground floor of the central building is placed the eating-hall; the school-rooms are on the first floor, lit by two rows of windows, so that there is properly no second story, except in the wings. All the left part of the central

edifice, and the left wing and its dependencies, are reserved for the boys; and the girls have the right part in a similar manner. The wings are thus respectively appropriated for the dormitories of the girls and the boys.

I remarked with pleasure, in the eating-hall, a portrait of the Duke of York, the founder of the institution; it is thus that the eye of youth should be enabled to view the likeness of princes, in the midst of the benefits which they have shed around them.

All the rooms are in an admirable state of cleanliness: but this, indeed, is what might be repeated of every establishment which can be visited in Great Britain. But regard to cleanliness does not stop at the care of the mere building; there is yet greater attention bestowed upon the personal cleanliness of the children. There are two of them in each bed, and the bedsteads are of iron instead of wood,* a circumstance which prevents vermin from lodging; over the heads of these beds are numbered shelves, on which the children deposit their clothes.—On the first or second of each month the whole of their linen, shoes, clothing, &c. is carefully examined, in the same way as in the regular army. At all seasons of

* The original savours somewhat of a *bull;* "les *bois* de lit sont en *fer*" is the expression of the author.—*Tr.*

the year, they are compelled to bathe twice a week for cleanliness, but never suffered to remain in water long enough to weaken them, or injure the development of their physical strength. Two baths, one for the boys, and another for the girls, are placed behind the colonnades which unite the left and right wings to the central building.—Independently of a large stone reservoir, where there is water for the children up to their necks, there are four fountains, each of which supplies water by fourteen cocks.—Two stop-cocks, one of which gives access to cold, and the other to warm water, afford the power of proportioning the water which flows from the fountains to the temperature of the atmosphere. To these fountains the children repair three times a day to wash their hands; before breakfast, dinner, and supper.—There is, in the room containing the baths and the fountains, a stove, with a large copper fixed in masonry, to heat the water necessary for these purposes of cleanliness. It will be conceived that it is requisite to establish perfect order, that twelve hundred children may enter and quit the bathing room in a limited time, after having completely bathed, or merely washed their hands.—To effect this regularly, therefore, two companies enter at a time by a large door; one company uses the two foun-

tains on the right side, the other those on the left; and the children as they finish washing pass out at a door, opposite to that at which they entered.

Each wing of the central edifice faces a very large court, reserved for the exercises and games of the children; for the same attention is paid to their amusements as to their instruction and labors. One colonnade runs the whole length of each court, along the wing which forms a side of the enclosure, and a second colonnade occupies the opposite side.—At both ends of this last colonnade are rooms, which are heated in winter, in order that the children, when driven in by cold and bad weather, may be able to amuse themselves there during the hours of recreation.

In the large court, reserved for the boys, they are taught to march in step, both in line and in files, and to perform even complicated movements, which they execute with much precision; but arms are never put into their hands. Whenever they repair to the school-rooms, as well as when they leave them, they are formed into companies, and marched by files in cadenced time, with an order and silence which are very remarkable.

Over the colonnade, in the court for exercise of the boys, which faces the central building,

there are two workshops, where the children are employed alternately on the days when they are not at study.—In the one shop they are taught the business of tailoring, in the other that of shoemaking. In this manner they learn to make and mend their clothing and shoes; and the wants of the establishment in these lines are supplied by their industry. A circumstance which had a very singular effect, was to observe in the central building, among the girls learning to read and write, little boys of five and six years of age, employed in receiving instruction in knitting stockings.

In teaching the children to read and write, the method of Doctor Bell has been followed, for particular reasons connected with the interests of the established church, in preference to that of Lancaster, as observed in the beginning of this chapter. The Prince Regent, in instituting regimental schools for the different corps of the army, caused it to be recommended to them to adopt, as a model, the method of instruction pursued in the military asylum at Chelsea.

The most advanced pupils, who perform the functions of monitors, are distinguished by one or two chevrons on the right arm, according to their respective ranks; they also command in the military exercises of their companions.

There is a master for every hundred boys, and a mistress for the same number of girls.

Infants are received into the school at Chelsea before they have completed their fourth year; the establishment even charges itself with orphans at the breast, who are sent out to nurse at the Isle of Wight; from whence they return to Chelsea at the expiration of three years.

On quitting the Military Asylum, the children are free to choose a calling in civil life; but the greater part of the boys prefer the profession of arms, and it is worthy of remark that even those who leave the school to enter on an apprenticeship to some civil trade, usually finish by returning to a military life, to the habits of which they have been practised in infancy. Napoleon perfectly understood this influence of early association when he transformed our peaceful seminaries of knowledge into barracks for military apprenticeship. It will probably require full half a century before the fatal effects of such a measure have ceased to operate upon the manners of the French nation.

The boys of the Asylum wear, in summer, a short close jacket with sleeves, and in winter a coat of the same color, made much longer before and behind, so as to cover them down to the middle of the thigh; the uniform is scarlet,

after that of the army. They have also blue stockings, and breeches of the same color, buttoned at the knee, a form of dress not favorable to the development of the muscular powers. I observed nothing remarkable in the clothing of the girls.

The food of the children is abundant and wholesome. In a back court opposite to the central edifice is a circular detached building, serving as a kitchen for the whole establishment; stoves, ovens, and economical apparatus for roasting are fixed there in admirable order. I enter into all these details, because they are essential to the good management and success of an establishment for public instruction, where the pupils are boarded.

The supreme government of the institution is confided, in the spirit of British administration, to numerous commissioners, forming a board, of which the commander-in-chief of the land forces is president. These commissioners are composed of the principal military authorities, the Chaplain-general, the Bishops of London, Winchester, &c. The presence of five members is necessary for deliberation, and of three for the admission or rejection of children presented as candidates for reception into the establishment. A commandant has direction of the routine of the institution, with re-

gard to discipline and instruction, and also of the expenditure, which appears to be regulated with equal economy and wisdom. We will give its outlines as estimated for the year 1819. The pay of officers, the clothing, board, and salary of masters and servants, the clothing and maintenance of 1250 children at Chelsea, and of 100 at the Isle of Wight, including fuel and all contingent charges, amounted to £28,161, making an average cost per child of less than twenty guineas. At Southampton, the expense per child was about the same, and the total estimated charge, for all branches of the Asylum for the year, was £36,482 : 17*s.* 7*d.*

It is surprising, that in place of sufficiently enlarging the fine establishment at Chelsea, the government should have preferred forming a second receptacle at Southampton, beyond the inspection of the superior authorities, and producing the additional expense of a second staff, and corps of instruction. The original expense of the building of the Asylum at Chelsea, purchase of the ground on which it is situate, &c. exceeded £100,000.

CHAPTER II.

The Royal Military College.

In 1799, the necessity of forming regimental officers, and more particularly those of the staff, with a perfect knowledge of the theory of the art of war, laid the foundation of the institution known under the title of the Royal Military College. In that year, thirty officers were admitted as pupils, and two or three professors appointed; in the following year the number of these last was increased to seven. In 1801, a royal warrant gave regularity to the attempt which had been made in the two preceding years. By this authority, a supreme board, composed of the Commander-in-Chief, the Secretary at War, the heads of the principal military departments, and several general officers, received a discretionary power to establish, by rules and statutes, the government and administration of the college.

The institution was divided into two departments, differing in the nature of the studies as well as in the age and rank of the pupils. That for officers studying for the staff of the army, which was reserved exclusively for such as had attained to manhood, was termed the

Senior Department; the other, for youths, previous to their entrance into the service, the Junior Department. We shall treat of each in particular, with the attention claimed by the importance of the subject.

The warrant of 1801 was superseded by the later regulations of 1808; the fundamental rules remained as before, but advantage was taken of experience to make improvements in many points of detail. The following is the definitive organization:

The supreme board of the King's commissioners is at once a council of administration and improvement; in it is vested the power of instituting such regulations as may from time to time appear desirable for the government of the institution, the preservation of discipline, and the improvement of studies.

The college is under the immediate command of a governor and lieutenant-governor; and there is also an inspector general of instruction.* All the military officers of the establishment are appointed by the royal commission, and subject to the articles of war, and regulations of the army. The name and rank of officers desirous of becoming pupils at the senior department; the names of all persons

* This office has been abolished.—*Tr.*

recommended by the Commander-in-Chief to the King, to enter as cadets into the junior department, must be submitted for the approbation of the Sovereign by the president of the supreme board, previous to their appointment to the establishment.

The supreme board names the professors and other persons in civil employ of the college, and regulates their salaries; but such nomination must be established by an act signed by five of the commissioners. When the situation of a professor becomes vacant, recourse is had, through the medium of the public prints, to advertisement, for a competition, in which the person best qualified obtains the preference. As an encouragement to men of distinguished talent to become professors, they are entitled, after fifteen years of service, to a retirement of one half of their salary, if recommended for this pension by the supreme board.* When a professor dies, having served the college five years or upwards, his widow has a right to the

* In case (the author should have added) of their health becoming such as to render them inadequate to a further discharge of their collegiate duties; for this is the proviso of the warrant. Their salaries are augmented, under the same instrument, by a regular scale of per centage from length of service, which, on the termination of the fifteenth year, amounts to one half of the original salary, the maximum of increase.—*Tr.*

same pension as the relict of an officer of rank, similar to that of the professor.

A collegiate board is charged with all details relative to interior arrangement and economy; it is composed of the governor, lieutenant-governor, and commandants of departments, three of which body are sufficient to constitute the board. The regulations and decisions of the collegiate board only become permanent, and their accounts are only definitively settled, when their proceedings have been examined and approved by the supreme board, to which they are entirely subordinate.

With regard to expenditure, all articles are procured for the establishment by public contract and competition, as far as such modes are practicable; and the annual estimates of the charge of the institution upon the public are submitted by the governor to the supreme board, before they are laid before the Secretary at War, to be included in the general estimates of the army. The sums voted by parliament for the college are then credited by the exchequer at the Bank of England, in the name of the agent of the institution, who draws them from thence as occasion may require, by authority of the supreme board, to whom he represents the specific objects for which the money is needed.

Expense of the General Staff of the College for the year 1819.

	£.	s.	d.
1 Governor	1,500	0	0
1 Lieutenant-governor . .	1,095	0	0
1 Inspector-general of Instruction	800	0	0
1 Chaplain and Librarian . .	300	0	0
1 Secretary to the Supreme Board	200	0	0
1 Agent	200	0	0
1 Paymaster	300	0	0
1 Surgeon	273	15	0
1 Adjutant	182	10	0
1 Quarter-master	182	10	0
Clerks	266	10	0
Charges for offices	300	0	0
Lodgings	200	0	0
Coals	322	15	3
Candles	80	9	4
Forage	401	10	0
Total . . .	6,604	19	7

Junior Department.

The junior department of the college, analogous to our French school of Saint Cyr, is devoted, as already observed, to the education of youths destined for the army. During their residence at the institution, these young men have the title of gentlemen cadets, and as soon as their instruction is completed, they are entitled to commissions in the service.* When

* The only species of claim to a commission, possessed by a gentleman cadet, is as the result of passing through public examination in the appointed course of studies before a collegiate

distinguished by merit and assiduity at their studies, they are sometimes permitted to continue at the college after their appointment to regiments, for a further prosecution of their acquirements in different branches of knowledge.

There are admitted as cadets into the junior department; First, the sons of officers of all ranks, whether of the land or sea forces, who have died in the service leaving their families in pecuniary distress; this class are instructed, boarded, and habited gratuitously by the State; being required only to provide their equipment on admission, and to maintain themselves in linen.

Secondly: The sons of all officers of the army, above the rank of subalterns actually in the service, and who pay a sum proportioned to

board, when he is recommended to the Commander-in-Chief, and provided for accordingly; but if the conduct and application to study of any youth at the college are favorably reported to the Commander-in-Chief by the governor, his friends are allowed to use their interest (although he may not have finished the course of instruction) in procuring him a commission either by purchase or under favor of the crown. In this case, the Commander-in-Chief usually grants leave of absence from his regiment after appointment to enable him to prosecute his studies at the college for a reasonable time, on application from the governor, if the young man's conduct continues good at the institution. The same leave of absence is also occasionally given, as mentioned in the text, to cadets obtaining commissions by public examination.—*Tr.*

their ranks, according to a scale per annum, regulated by the supreme board. The sons of living naval officers, of rank not below that of master and commander, are also admitted on payment of annual stipends, similar to those of corresponding ranks in the army.

The orphan sons of officers, who have not left their families in pecuniary difficulties, are admitted into this class on paying the stipends required of officers of the rank held by their parents at the period of their decease.

Thirdly: The sons of noblemen and private gentlemen, who pay a yearly sum, equivalent to the expenses of their education, board and clothing, according to a rate regulated from time to time by the commissioners.*

Candidates are only admitted into the junior department between the ages of thirteen and sixteen years; and must be free from any physical or mental infirmity which would incapacitate them from the military service. Some

* The present rates of stipend, required by the regulations of the college, from parents of cadets on the second establishment, vary from £70 to £30 per annum, according to the gradation of ranks, from the general officer to the captain, without distinction of full or half-pay.

The subscription of a cadet of the third establishment is £125 per annum for instruction, board, clothing, washing, medical attendance, &c. &c.—*Tr.*

previous acquirements, the precis of which is determined by the supreme board, are requisite to qualify candidates for admission.*

Establishment of the Junior Department for 1819.

	£.	s.	d.		£.	s.	d.
1 Major . .	351	6	3	13 Musicians .	355	17	6
4 Captains .	1,095	0	0	6 Clerks . .	520	8	0
1 Adjutant .	182	10	0	37 Servants .	1,358	11	3
320 Gentlemen Cadets	14,600	0	0	1 Armourer .	54	15	0
1 Serjeant Major .	73	0	0	Total Military Establishment	19,248	8	0
12 Serjeants .	657	0	0				

Instruction.

	£.	s.	d.
1 Professor of fortification	265	12	6
3 Masters of ditto	617	7	6
4 Professors of mathematics . . .	1,095	12	6
3 Masters of arithmetic	647	17	6
4 Masters of classics, geography and history . .	756	11	11
5 Masters of French	988	9	4
2 Masters of German	327	4	1
2 Masters of landscape drawing . .	498	0	0
6 Masters of military drawing . .	968	19	7
Teaching astronomy, chemistry, &c. .	250	0	0
Total expense of instruction .	6,415	14	11

* The preliminary qualifications demanded of the candidate are regulated with retrospect to the nature of his previous education. He must either pass an examination in the four elementary rules of arithmetic, with the power of construing such Latin authors as Virgil, Cæsar, Ovid, &c. with tolerable fluency; or, if his instruction has not been classical, all examination in Latin is dispensed with on his prov'ng a perfect knowledge of

	£.	s.	d.
Board	8,299	12	1
Clothing	3,477	11	0
Washing	870	1	0½
Fuel	1,840	6	3
Candles, lighting, &c.	414	3	4
Different other expenses	5,865	19	10
General Total of the expenses of the junior department for 1819	*46,431	16	5½

Having given this outline of the organization of the junior department, I proceed to an account of the observations which I had an opportunity of making in my visit to the establishment in the summer of 1819. Sandhurst, where the Military College is situated, is about thirty miles from London on the western road; on the way thither from the metropolis, you cross the plain where King John was constrained to grant the Magna Charta to his subjects, whom his tyranny and bad faith had driven to revolt. You afterwards gradually ascend an irregular hilly tract of country, from whence the eye wanders in every direction over vast plains of heath of frightful sterility. It

arithmetic as far as vulgar and decimal fractions, &c. English grammar and orthography form a part of either examination. —*Tr.*

* Instead of this sum, (the pay of 320 cadets being placed against their board, clothing, instruction, &c.) the actual expenses formed but £31,831 : 16*s.* 5½*d.* of which about £18,000 was defrayed by the stipends required of cadets of the second and third establishments, and the remainder by parliament.—*Tr.*

is not until you approach the vicinity of the college, that you can perceive here and there an occasional plantation of young firs, the principal extent of which is either on the property of the Duke of Gloucester, or of the college. This uncultivated appearance of the country enhances the magnificence of the buildings of the Military College. In the midst of extensive grounds disposed in the English style, is a large sheet of water, from the edge of which, an esplanade rises with gentle ascent to the principal front of the edifice. The centre of this front is adorned with a portico of the Doric order raised upon eight majestic and beautifully proportioned columns. The main building is composed, like most English habitations, of an under-ground story, a ground floor and a first story. Two ranges of houses, extending at right angles, to its rear, are appropriated for the quarters of the officers, and with the principal building itself, form a square, near which, on some rising ground, is placed a small astronomical observatory. At both extremities of the body of the edifice, in the same direction of front, but a little retired, are porticoes, of much smaller dimensions than that at the centre, which extend to two wings, appropriated as part of the sleeping rooms, studies, &c. Beyond these wings again, are similar porticoes,

leading to buildings of regular construction, one of which is the hospital of the establishment, and that corresponding to it on the other side, the house of the lieutenant-governor. In front of the grand line of buildings are placed cast iron supporters for lamps of beautiful antique structure, and upon a very large scale. To enter by the central portico, you ascend a broad flight of steps leading into a spacious vestibule, which is decorated with very pretty cast iron arm-racks, surmounted by the standards and camp colors of the battalion of gentlemen cadets, and with arms, drums, and other military emblems ranged within and around them. An apartment opening into the vestibule on your right hand forms the guard-room of the gentlemen cadets on duty, while the corresponding room on the left hand is occupied by the officers at their periods of attendance in college. Opposite to the entrance of the vestibule are doors leading from it into the chapel, the decorations of which are simple and pleasing. The benches on the floor of it are divided into four compartments for the four companies of cadets, with pews for officers, professors, &c.; and in the galleries are the seats of the governor, lieutenant-governor, officers' families, &c.

On returning again into the vestibule, you observe on either side a long corridor which extends the whole length of the main building, and opens into the dining halls, halls of study, &c. to the right and left. There are four dining halls, for the companies respectively, at each of the tables in which ten of the youths dine, a cadet non-commissioned officer presiding. The firelocks, accoutrements, &c. of the young men are deposited in racks, which line the walls of these apartments.

In one of the halls which you enter from the main passage or corridor, is the model of a place regularly fortified after the system of Vauban. This model, on which are represented the approaches and all other operations of a siege, is twenty-four feet in diameter, of massive mahogany, and perfect correctness of execution.—It was constructed under the direction of the Professor of Fortification at the College.* In another room, communicating with this by fold-

* M. Polchet, and not Porcher, as stated by the author, a gentleman of high talent and professional attainments, which have, indeed, been conspicuously displayed in the construction of this splendid model. It is composed of one-half of an octagon, fortified after Cormontaingne's improvement upon the systems of Vauban, and contains an exact and beautiful representation of the whole progress of scientific attack and defence.—*Tr.*

ing-doors, is a collection of models of field and siege artillery, fascine and sand-bag batteries, military bridges, mines, mode of defilading works, &c. &c.

There are no large amphitheatres for general lessons in the Military College, as in our academies of the first rank; these are here supplied by halls of study, with a semi-circular or horse-shoe table in each, sufficient for about five-and-twenty pupils to sit on the side opposite to the master, and facing the small desk at which he is placed. For mathematical instructions, large slates, or black boards, are suspended, and on these the pupil traces the figure from which he demonstrates his proposition.

The dormitories are situated on the first floor of the central building, and in the wings; every room contains five beds, occupied by the same number of cadets; an under-officer presiding in each chamber, who is responsible for the good order and regularity of his charge. The dress of the youths is neat and handsome; and plainly evinces that there is here no regimental colonel to profit by the cheapness with which the clothing can be supplied, in carelessness of its quality. The uniform is composed of a scarlet coat, with blue facings, as in all royal corps; with loose pantaloons of the color of the facings.

The head-dress is either, for ordinary occasions, a blue cloth cap with the letter and number of the company in front in a neat star, or the chako in full uniform. The students are instructed in all the military exercises, and march with much steadiness. They have a band, the individuals in which are practised in the bugle, as well as the usual martial concert instruments; these musicians are boys selected from the Military Asylum, and, of course, form a class distinct from, and inferior to the gentlemen cadets.

Military discipline is preserved at the college with scrupulous attention; but it does not prevent the youths from feeling that they are candidates for the profession of arms of a privileged rank. This is evident from the air of pride which is observable in their carriage, at an age when bashful timidity or unassuming frankness is the usual characteristic.

It appears, that in the prosecution of the studies, more attention is bestowed upon the mechanical labors of the hand, than upon those of judgment and intelligence. An extreme importance is attached to the art of drawing generally, and more particularly of landscape drawing, coloring, &c. The most beautiful landscapes, executed by the young men, are pre-

served for ostentatious exhibition in the public room of assembly of the collegiate board and commissioners.*

Although only the elements of mathematics are taught at the institution, the military college has had the distinction of numbering among its professors, in the few years of its existence, two of the most eminent mathematicians of Great Britain, Ivory and Wallace.

The houses of the professors are small and incommodious. They are ranged, two houses in a building, in regular order, and at equal distances, forming a line of terrace, which is decorated in front with ornamental plantation; every house has its garden in rear. This terrace is about half a mile from the college, and at somewhat less distance is the mansion of the governor, in the midst of spacious grounds.

* The drawings here mentioned are principally military plans of ground, battles, operations, &c. with a very small proportion of landscapes. The former are certainly of great beauty, and, as such, preserved for the inspection of visitors; but it would be difficult to discover why the author argues from thence that more weight is attached at the college to skill in mechanical operations than to the "labors of judgment and intelligence."—Military drawing is a highly important branch of professional education, and is, doubtless, regarded as such in the course of instruction pursued at the college; but its mechanical details are by no means suffered to occupy more time or attention than they merit.—*Tr.*

The rank of the pupils, on quitting the establishment, is regulated in order of succession, according to examinations entered into for ascertaining their progress, and, particularly, from the results of notes which are taken of their conduct. This latter part of the valuation, which must rest so much upon the caprice of those in command, is opening the door to partiality, likely to prove fatal to all emulation among the young men. In a large establishment for education, decidedly bad subjects should be dismissed altogether, and then those remaining estimated by their talents alone; this is the only mode of ensuring that true merit shall never be damped, and genius always rewarded.*

* We cannot agree with our author, that irregularity of conduct, provided it fall short of a degree to deserve expulsion, should, in any scholastic establishment, be considered as of no moment in the estimation of merit. But there are peculiar features in the constitution of the military college, which render it indispensable that much regard should be had to behaviour, in regulating the order of precedence among the youthful students. The strict discipline maintained at the institution is built upon a system of prevention, rather than of punishment. There is no flagellation, no weekly exhibition of the birch as the sovereign remedy for all disorders, because it is one of least troublesome application by the preceptor. In this absence of corporal punishment, then, it becomes the more necessary to strengthen the incentives to good conduct, by the certainty of reward, and the hope of distinction. The boy of genius is

Senior Department.

The object of the Senior Department of the college is to instruct officers already in the service, in the scientific parts of the art of war, that they may afterwards be enabled to discharge, with the greatest possible advantage, the functions of commanding officers of corps, or of situations on the staff of the quarter-master and adjutant-general, whenever promotion, or the circumstances of warfare may summon them to such employments.

General Jarry, who had quitted the standards of his country at the same period as Dumourier, was originally charged with the organization of the senior department; and a more advantageous choice could scarcely have been made. This officer, who was a man of splendid abilities, had, for twelve years, directed (in Prussia) the first school for the staff which existed in Europe; an institution of which Frederic the Great thus

taught that something more is requisite than a presumptuous confidence in his abilities, and the youth of less talent may feel the assurance that correct behaviour will add weight to his claims to success, in competition with his fellows. Will this, or a contrary system, of upholding intellect at the expense of every other consideration, be most likely to yield the greater number of useful members to society, and to the profession of arms?—*Tr.*

expresses himself, in his memoirs of the period between 1763 and 1775, *(Chapter on Military Affairs.)*

"The army had made numerous campaigns, but the quarter-master-general was often in want of good officers for his department. The king wished to form a corps of such officers, and selected twelve individuals, who already possessed some slight acquaintance with engineer duties, for the purpose of instructing them himself. With this view, they were made to sketch country, mark off camps, fortify villages, entrench heights, construct stockades, regulate columns of march, and, above all, to try the nature of marshes, and the depth of streams themselves, that they might not be deceived by the negligence of others, and cause an army to depend upon the defensive support of a fordable river, or of a marsh which infantry could cross without being ancle deep."

Since the death of Jarry, the senior department has been directed by Colonel Sir Howard Douglas, son of the admiral who introduced gunlocks for naval artillery.*

* He is himself author of several military treatises. He published, in 1816, an Essay on the Principles of Construction of Military Bridges; and has lately produced a little book against the "System of Fortification," of the celebrated Carnot, dedicated to his grace the Duke of Wellington. In this last

We shall begin by stating the conditions of admission to the studies of the senior department of the military college; we shall afterwards explain the plan of the studies, and mode of instruction. To be received as a student of this department, an officer must be one-and-twenty years of age; he must have served with his regiment three years abroad, or four on home duty, and be able to produce certificates from his commanders, not only of good character and conduct, but of his practical knowledge of the discipline of the arm to which he belongs. These testimonials are to be addressed to the governor by the commanding officer of the candidate's corps, if he judges him deserving of such an indulgence, as the permission of studying at the college; and may be accompanied by all the observations which he has to make upon the conduct and talents of the individual. No

publication, Colonel Douglas has not done justice to the profound views and generous character of our illustrious engineer. It is to be regretted that, hurried away by the violence of refutation, he has followed the method too common with certain critics, in whose eyes, to refute what is incorrect in the writings of an author is nothing; his character must also be blackened, and an attempt made to disgrace the individual, to gain an easier triumph over his work. It is beneath the honorable character of an officer to suffer himself to be led away by such examples, even unintentionally, and in the heat inspired by controversy. *Author.*

officer is received into the senior department until he has undergone a preliminary examination in a satisfactory manner, and before the King's approbation has been conveyed to the governor for his becoming a student, through the medium of the commander-in-chief.

The pupils of the senior department make an annual contribution to the funds of the college, which is at present fixed at thirty guineas per annum. During their residence at the institution, they wear the uniform of their respective regiments, and continue subject to military discipline and law. After having finished the course of their studies, and undergone an examination, by which they are found to be qualified to perform all the functions of staff-officers, they receive a certificate to such effect from the collegiate board; at the same time their names are inscribed in a register, that the commander-in-chief may, at the moment of need, be acquainted with them, and summon them for the adjutant and quarter-master-general's department.

The outline of the system of instruction at the senior department embraces the mathematics, fortification, castrametation, military topography, reconnoissance of ground, estimation of the military resources of a country, disposition and movement of troops under the dif-

ferent circumstances of offensive and defensive warfare; French, German, &c. Two years and a half are requisite for performing the circle of these branches of instruction; and some officers obtain permission to remain as long as three years at the college, to extend and give greater depth to their studies, and to familiarize themselves with the best treatises upon the art of war; of which a chosen collection has been made for the benefit of the establishment. To induce application to the study of languages, the students are made to translate such works as contain information most likely to be of service to them, or are most attractive, from the interesting nature of their contents. The German and French languages have been preferred as points of instruction at the college, because the greater number of good military works are written in one or other of these tongues; in case of need, it would be easy to instruct the students in the language of any other countries which might chance to be the seat of war.

More time is now given than formerly to the mathematical sciences, and the study of them is carried farther; the principles of astronomy have also been united to this branch of the collegiate instruction, and, with them, information on the nature of all instruments necessary to topographical operations on the great scale.

The greatest attention is bestowed on the drawing of military plans, and of the systems and methods of fortifying.—Many students attain remarkable proficiency in the different modes of executing military sketches with the pen, and camel hair brush, in Indian ink and general coloring.

For practical instruction in military surveying in the field, the officers carry out with them on horseback or on foot, a sabre-tâche or case of leather, of about fourteen inches square, which is slung round the shoulder.—It is exactly of proper size to contain sheets of asses' skin well polished, upon which the rough sketch is taken on the spot, for the plan to be afterwards finished within doors. As all these sheets are of the same size, they accord exactly with each other in laying them together to form a plan, of whatever dimensions.—On the back of the sabre-tâche are four small leathern grooves, one at each angle, to receive the corners of the skins on which the sketches are made; when the skins are thus fastened in, and a base taken on them for the intended sketch, the sabre-tâche answers as a flying plane-table. The officers in their surveys adopt a fixed scale, which renders the comparison of their labors perfectly easy, and a complete plan is at once procured by simply uniting the isolated work of each.—To

habituate the officers to master every difficulty, they are made to sketch the country in the environs of the college (under superintendance of a master) without the assistance of any map of its general features and localities.—Afterwards, in more extended surveys for practice, they are allowed to make use of the materials afforded by common maps, to procure the positions of towns, rivers, and great roads, that are well known, which they fill up with the greater minuteness of detail necessary for military operations. As the officers in the course of their residence at the college have frequent and long journies to make, in the formation of their plans and positions of defence, &c. they are each allowed forage for a horse by the public, during their stay at the establishment.

The students also pass through a complete course of fortification, which they commence by drawing plans of the different systems.—All difficult operations, such as defilement of works, are explained to them by models in relief, with threads stretched in the direction of the lines of fire from which it becomes necessary to defile. —The college possesses a very complete set of such models. When the students have been sufficiently instructed in theory, they make application of its principles in projects of defence for supposed posts in the neighbourhood. The

senior department has its seat in the small town of Farnham, about ten miles from Sandhurst, in the vicinity of a military position of the utmost importance for the defence of Great Britain.—Beginning from Farnham, a chain of hills extends towards Guildford, in a direction nearly parallel to the sea-coast, and forms a sort of natural rampart for the south of the centre of England. The Medway lies in front of the chain of hills, and presents the ditch for this natural fortification.—The various points of such a position afford the students an inexhaustible subject for their studies, and application of principles to practice; and, in case of any invasion of their country, would besides give them an advantageous acquaintance with the strong and weak points, resources, &c. of that line of territory.

When the students have acquired a sufficient knowledge of a given tract of country, they are required, besides laying it down in military survey, to prepare a plan of resources and defence, as an accompaniment to their sketch.—They must explain the particular nature of the country, its population, state of cultivation, and description of productions; its rivers, rivulets, fords, roads, canals, and bridges; its resources in grain, horses, and carriages; its military positions, with the means of defending them; and

they must, further, furnish a plan for encamping or cantoning a certain number of troops upon one or several points. For the march of an army, the student must know how to mark out the routes to be taken by different columns, and to calculate the number of troops, and the description of force to direct upon each road, to arrive at any position in a given time.

The officers undergo a weekly examination on the different points of instruction through which they are passing.

I have not yet spoken of the buildings appropriated to the senior department; they stand in one of the streets in the town of Farnham, and have nothing remarkable in them.

Estimate of the Expenses of the Senior Department for 1819.

Professors.	£.	s.		£.	s.
1 Of Mathematics .	405	0	1 Clerk	156	10
1 Of Fortification .	230	0	1 Barrack Serjeant .	28	18
2 Military Draftsmen	457	10	3 Servants . . .	137	12
1 Of French . . .	182	10	Lodging Money . .	717	9
1 Of German , .	243	0	Forage	1,053	19
Teaching Natural and Experimental Philosophy	100	0	Other Charges .	1,056	2
			General Total . . .	4,868	10
Deduct the Subscription of thirty Students at thirty Guineas each per Annum . . .				945	0
Sum to be provided by Government				*£3,923	10

* As a considerable change has lately been effected in the organization of the military college, some further details upon

its present establishment may not be wholly unacceptable to the reader; particularly as the author's account of the institution is generally defective, and often inaccurate.

In June 1820, the senior department, which, as the author has stated, previously existed at Farnham, at the inconvenient distance of ten miles from the body of the college and residence of the governor, was transferred to Sandhurst, and consolidated with the other branch of the establishment. This measure was attended with the greatest advantages; the heavy expenses of the staff at Farnham, of additional professors, servants, buildings, &c. &c. were saved to the public; the department was brought under immediate inspection of the governor,—a highly desirable circumstance; and, at Sandhurst, the students were enabled to share in the benefits of the astronomical observatory, model of attack on Cormontaingne, and other encreased facilities of instruction: at the same time, the regulated period of residence of an officer at the college, which had been suffered to grow to nearly three years, and frequently even then without terminating in public examination, was reduced to one year, and higher qualifications were demanded on admission. These arrangements have, altogether, not only ensured a greater probability of improvement in the students, but enabled an additional number of officers in the army to participate in the instruction afforded at the institution; because, though the establishment is only fifteen instead of thirty, the accelerated succession much more than doubles the number of students in three years. After this consolidation of the two departments, and other reductions of expenditure, the sum required of the public for the current services of the college for 1821 was little more than £16,000, while the parliamentary vote of 1819 for the same purpose exceeded £24,000.

The course of studies of the senior department has been detailed by the author with sufficient accuracy; but, of the plan of education of the junior branch, he has given no information, and seems, indeed, to have acquired little himself. The prin-

cipal studies of the two departments, so far from differing in nature as he asserts, are composed of essentially the same course in mathematics, fortification, military drawing, and languages; the only points of distinction being, that, in mathematics, the officers proceed somewhat farther than the cadets, and that their military surveys are more extended. We shall here offer a slight outline of the instruction at the junior department.

The course of mathematics rises in the following order: arithmetic, algebra, nine books of Euclid's geometry, plane trigonometry, mensuration, spherical trigonometry, conic sections.

That of fortification, which commences when the pupil has acquired the elements of practical geometry, comprehends the study of the three systems of Vauban, the method of Cormontaingne; horn, crown, and other advanced outworks; the principles and mode of construction of every species of field-works; the science of attack and defence, &c. The whole of this instruction is illustrated by lectures, and assisted by models of all descriptions.

Military drawing is naturally divided into the art of copying plans with correctness, with facility, and neatness of execution; and that of laying down the military survey of a country from nature.—The latter part of the course is acquired after the pupil has undergone public examination for a commission.

The French and German languages are taught in the usual manner; and at the public examinations in these branches of study, the pupil is required to translate any portion of a given author, *vivâ voce*, and at command, into English, and of another writer from English into the foreign language. The Latin classics form also a department of instruction, and it may be sufficient to observe, that the requisite for public examination on this head consists in being prepared in the whole of a chosen author, generally either Juvenal, Livy, or Tacitus, so as to construe any part that may be selected at the moment.

Beside these points of attention, every youth on joining the

college, is made to pass through a course of geography and of general history, ancient and modern. English composition is also taught, and there are lectures on natural and experimental philosophy.

Each branch of instruction at the institution is divided into classes, through which the pupils gradually rise by monthly examinations of great strictness.

The attainment of a commission in the service being considered as the object and termination of the course of instruction, there are two modes of arriving at this end by public examination.—These are either, by preparation in the whole course of mathematics, fortification, and military drawing, with tolerable proficiency in languages ; or, by public examination in successive sessions in any three of the four following branches of knowledge: viz. French, German, Latin, general history ; supported by certain qualifications in geometry, fortification, and military drawing.—*Tr.*

CHAPTER III.

Practical School for the Engineers, at Chatham.—Royal Military Repository at Woolwich.

The practical school for the engineers, an establishment which was long a desideratum with the most enlightened British officers of that arm, was created by a warrant of the 23d of April, 1812. It has, ever since its foundation, been directed by Colonel Pasley, who introduced himself into notice by his work upon the Military Policy of Great Britain, and has since published, for the studies of the school, a course of instruction on the elements of mathematics and fortification, as well as a volume of standing orders for the discipline, service, and labors, of the engineer department.

As soon as recruits for the troops of the engineer service have been formed at Woolwich to the common exercises of the soldier, they are sent to Chatham, there to receive the theoretical and practical instruction necessary for the sapper, miner, and pontonnier; every engineer soldier being trained to the performance of the duties of all these branches of the profession.—In the same manner, as far as the exigencies of the service will admit, the young officers of en-

gineers, on quitting the academy at Woolwich, are sent to Chatham, to acquire practical knowledge; as are also the officers and troops of the East India Company's engineers, who have been permitted, since the year 1817, to share in the instructions at Chatham, on payment by the Company of all the expenses of such tuition.

The military artificers instructed at the school of Chatham are organized into companies under orders of engineer officers;* and the officers and men sent to the school are entirely under orders of the director of the establishment.—He is seconded in his functions by an assistant-director, who is charged with the execution of his orders, and with the special superintendance of studies and works;—by an adjutant, for military instruction and the details of the service;—by a serjeant-major, who acts generally, and for all the companies of the engineer troops, keeping a register of the progress of the non-commissioned officers and soldiers, in double relation to military exercises and works of art;—by a quarter-master-serjeant, charged with all the matériel of the troops, their effects,

* Every officer attached to the school, either in command of artificers, or as a student, must be provided with a case of mathematical instruments, a box of colors, and a pocket-sextant; as well as the infantry regulations for manœuvres, discipline, &c.—*Author.*

clothing, equipage, arms, ammunition, heavy baggage, &c.; this non-commissioned officer orders and superintends the repair of the clothing of the soldiers; he has the inspection of the barracks, and is responsible for the cleanliness of the rooms, courts, parades, &c.; the men on duties of fatigue, or in quarters, are under his immediate inspection, and he is present at and superintends the issues of provisions.

The serjeants are treated with particular distinction, and whenever they commit any fault, are sent to their rooms in arrest like officers; and if one of them were, forgetting his rank, found to drink with the soldiers, he would be tried for the mere fact, and degraded on proof of it.

The companies have bugles instead of drums; a much more suitable plan for men who are often liable to be distributed over considerable extent of ground, in making gabions, fascines, palisades, or other works. It may be remarked also, that the bugle is very light, and portable, and does not prevent the man who bears it from working with the rest. The English appear to me to have attained great perfection in the fabrication of their military horns; this is an object worth the attention of our own manufacturers.

The engineer companies quartered near the

school are organized in such a manner as to be able to embark at any moment when ordered, without the slightest delay. It is requisite, therefore, that their matériel, accounts, and discipline, should be constantly in condition, consistent with such a rapidity of execution.

The barracks of the engineers at Chatham are a model of arrangement, grandeur, and simplicity, and are kept in high order.

But it is time to speak of the studies and works of the practical school. In the distribution of hours, the utmost care is observed not to fatigue the intelligence of the men, and to avoid weakening their physical powers by excessive study. Every day, Sundays excepted, the soldiers turn out in their working dress, in summer at half past six o'clock in the morning, and in winter at half past seven. They are allowed half an hour for breakfast; after which they repair to their different classes in the school, where they remain until nine in the summer, or half past nine in the winter: the remaining portion of the day is devoted to works in the open air. When, however, the weather is such as to prevent a prosecution of this latter description of instruction, the artificers remain in the school until eleven in the morning, and return there again in the afternoon, for three hours in summer, or three and a

half in winter. If either soldiers or non-commissioned officers wish to continue their studies beyond the regulated hours, books and instruments are lent to them for the purpose; but they are of course answerable that they receive no damage.

The object of the studies of the practical school is to teach every artificer of the engineers how to draw out a report, an estimate, an account, and a plan of all works of art, which he may be required either to superintend or execute himself.

First, There are reading and writing lessons for artificers who are ignorant of those elementary branches of instruction; Bell's system is followed in these classes.

Secondly, When the artificers can read and write, they are passed into the classes in geometry, in which they pursue the first volume of Colonel Pasley's Course of Military Instruction; still adhering to the plan of mutual tuition, as in the former classes.

Thirdly, When they understand the elements of geometry, the pupils learn to draw the plan, section and elevation, of a simple building without ornaments, and upon a given scale.

Fourthly, They commence the study of fortification, and draw, successively, the plan and profiles of a regular octagon, fortified upon the

system of Vauban; of a field battery; of a small powder magazine; of approaches and parallels for the attack of a place; and lastly, they copy the tracings necessary in the art of mining.

Fifthly, They are instructed in arithmetic and mensuration, to enable them to calculate length, superficies, and volume, with their constant application to the labors of fortification.

The soldiers and non-commissioned officers of the engineer service are thus taught geometry and fortification, before the most advanced rules of arithmetic, because it is argued, that they may learn this latter science any where, whilst they would in no other situation enjoy the same facility with respect to the two former.— By means of the plan thus followed, it is conceived that they may be put into condition, in the shortest possible time, to quit the establishment with adequate knowledge, in case that the exigencies of the service should not allow leisure for completion of the whole course.

Colonel Pasley states, that he has observed, that children learn arithmetic more easily than geometry, while the contrary is the case with persons arrived at manhood: this remark is worth notice, as well as another observation made by the same author, that the age, most advantageous for instruction with men, is that from twenty to thirty years.

Independently of the school for non-commissioned officers and soldiers of engineers, there is also established a regimental school for the children of the troops of that service, in which the same mistress teaches the daughters of the non-commissioned officers at different hours from those of the privates. The practical engineer school is in the great barrack; the other, in one of those of the south line.

The mode of instruction, by mutual tuition, in reading, writing, and arithmetic, is now so universally understood, that an explanation of the process would be superfluous: but the case is otherwise with the application of the same method to the study of fortification, which I witnessed with extreme interest; and I shall therefore attempt to afford an idea of the manner in which it is conducted.

A range of tables, disposed in directions parallel to each other, is placed opposite to the board for explanations, which hangs perpendicularly; the pupils are classed by tables, in their order of merit, and each is provided with a rule, slate, and chalk pencil. The monitor, similarly furnished with a rule and chalk pencil, is at the perpendicular board: he begins by explaining the magistral lines of the system of Vauban.—He successively commands them—

I. *Trace a flank of a bastion—write the word*

flank, and the word bastion—show your slates. At this last command, the first pupil of each table rises and visits the slates of his table: if any one is then found to have committed a fault, either in the drawing or writing, he loses a place, and passes to the left of the person next below him. II. *Trace the face next to the flank—write the word face—show your slates.*—Then follows the same inspection as before. III. *Trace the second face and the second flank of the bastion—show, &c.* IV. *Trace the curtain adjacent to the second flank—show, &c.* V. *Trace a second bastion.* The pupils thence pass successively to the tracing of the demi-lune, ditch, covert-way, &c.—In another lesson, the learners are instructed how to trace a profile, to determine reliefs and commands, &c.

All these points of knowledge, which might be learned in a few hours by men thoroughly familiarized with geometry, are here exhibited in a gradation so gentle, that the slowest understanding can follow the operations, without the slightest painful effort. The pupils are not merely shown how to distinguish, name, and write down correctly, the different parts of a fortification, and to draw something like them on a slate, but they are, besides, made to lay down these parts exactly with the rule and compass, first in pencil, and afterwards in In-

dian ink. It is not intended that they should produce beautiful drawings, but only the tracings of works of sufficient accuracy for practical purposes.

After having taught the pupils whatever is essential in the forms and received dimensions of permanent and field-fortification, they are instructed how to proportion and draw such accessory objects as gabions, fascines, chevaux-de-frise, &c.; and then they pass to the attack and defence of places.

Throughout all this course of fortification, every endeavour is used to facilitate a perfect understanding of the works under explanation. Plans of fortifications in relief are exhibited to the learner, with the flanks, faces, curtains, and, in a word, all the different parts formed out of separate pieces of wood; after confusing these in a heap, the pupil is directed to restore them to their proper relative situations, just as children are taught how to put the fragments of a dissected map together. Some parts of works are cut down perpendicularly, so as to present the section of their proportions, with the revêtement painted on it, in order that the students may distinctly comprehend what portion is composed of masonry, and how far that masonry extends.—They are examined upon the subject of these models by being desired to

point out a bastion, a demi-lune, a covert-way, a glacis, a face, a flank, the ditch, the scarp, the counterscarp, &c. These details may appear puerile; but, in fact, they must be so to attain the object in view. Ignorance is, at all ages, the infancy of the mind, and must be dealt with accordingly.

When the men under tuition become more advanced in knowledge, they are required to trace upon the board at the moment, and without any species of assistance, either the plan of a part or the whole of a front of fortification, or a vertical section cut through the face of a bastion, demi-lune, &c. I have seen serjeants undergo such examination, with a facility of design, and readiness in using the pencil, which were very remarkable.

As soon as the students are familiarized with all the elements of fortification, they are rendered equally so with the works of attack and defence. A large model of a fortified place and its environs, with all the accidental features of ground, is provided for the purpose, showing a camp at a distance, and, nearer, the parallels, approaches, and, in a word, all the operations of a siege. There are also models of boyaux-de-tranchées in relief, by means of which a line of attack is marked out, and the pupil directed to show the manner in which a sapper should

advance from a given point; if the learner does this correctly, and supposes the direction taken by the sapper to be one which gains the greatest possible ground without exposing himself to enfilade, it is evident that he has understood the explanations contained in the theoretical course.

There are many other models in the two rooms destined to form a repository of fortification.—I particularly noticed one of the number, a blockhouse redoubt, constructed by the British on one of the mountains of the Pyrenees, at a point to which no artillery could be brought. It was a hexagonal wooden tower, raised upon a mass of earth, in the shape of the frustum of a hexagonal pyramid, which was dug out to form the excavation of the ditch. The roof of the tower was a hexagonal pyramid, the summit of which was supported by a pillar. Beyond the ditch was a simple covert-way, from whence the defenders could throw small shells by the hand, which their weight would cause to fall into the midst of the assailants. This redoubt contained two hundred men, and provisions for a certain number of days.

There are models showing the best means of repairing, with rough pieces of timber of moderate size, arches of bridges destroyed by an enemy.—Others represent the most advan-

tageous point for attaching a mine to a bridge, to blow it up, with the probable breach which would appear after the explosion. Rope-bridges, and other expedients for procuring a military passage over rivers, are also placed in the same rooms. The whole of these models are made by the engineer soldiers themselves, and the very execution of them becomes a means of instruction of the most efficacious nature. Independently, also, of durable models, calculated for the permanent tuition of the school, the artificers raise small models in earth, of works of field fortification.

The troops of the engineer service are provided with a library, by the liberality of the ordnance department; and it frequently happens, also, when a company of the sappers and miners are ordered to a foreign station, that the soldiers and non-commissioned officers make a common subscription, to form a collection of books, which is afterwards carefully augmented.

While so much attention is bestowed upon the theoretical studies of the artificers, their exercises and labors are objects of no less care. In all seasons, one day in the week is entirely set apart for military exercises; and, in the summer, the non-commissioned officers are assembled twice in the week, at six o'clock in the afternoon, to be practised in the different duties of commanding platoons.

The practical labors of the sapper and miner are prosecuted on a tract of waste ground, between the Medway and the engineer barracks. The workmen are employed in constructing field-forts, breast-works for batteries, and the sape, making gabions and fascines, using them in executing works, &c. I saw some small forts extremely well constructed; and the ground on which others had lately been thrown up and destroyed again; chambers and galleries of mines, &c. A certain number of the artificers of the engineer service are likewise taught how to repair and build pontoons. In going from Chatham to Sheerness, I met, opposite to the front of fortification where the casemate barracks of the engineers are situated, the pontonniers at work upon the Medway, in throwing a bridge over that river for practice. They had, upon drays, their pontoons, and also series of casks, strongly fastened, side by side, to each other by sleepers of timber. The soldiers launched a pontoon and a raft alternately; guided them in turn upon the line of the intended bridge, moored them with small anchors, accomplished the passage, covered the bridge with planks, &c.; and performed all these operations under command of the non-commissioned officers, and directed by their officers, with as perfect order and regularity as

could be done, in time and movement, at an exercise with cannon or small arms. But the artificers are practised in manœuvres of more difficulty and peril. The bridge at Rochester (above Chatham) being built with very narrow arches, and large piers, there are caused, according as the tide runs above or below the bridge, currents and counter-currents of extreme velocity; and it is at the points where these are strongest, that the artificers are exercised in operations suited to torrents of the utmost rapidity. Notwithstanding the danger of these labors, precautions are so well taken, and the method of proceeding so perfect, that an accident of consequence can scarcely occur. It may be learnt, from these details, how much care the ordnance department extend to the practical instruction of the troops of the engineer service. In the execution of all these works of practice, every effort is made to attain the utmost perfection. In proportion as such labors become familiar to the artificers, they learn to perform, both with rapidity and exactness, what they were at first content to effect with exactness alone. The officers, non-commissioned officers, and soldiers, are carefully habituated to the strictest economy in the use of wood, cordage, and tools; every thing is done with method and foresight; and negligence, or

merely simple want of thought, where it relates to objects with which it was requisite to be provided in anticipation of contingencies, is blamed, reprimanded, and even punished, if occasion require it.

If any new operations, which appears likely to be useful to the engineer service, needs a practical trial, a captain of engineers has superintendance of the business. Should he be able, after a certain time of experiment, to reduce it to a series of more regular and advantageous processes, he draws up a plan of execution. This plan, reviewed, and, if necessary, revised by the director of the school, is entered into the collection of standing orders, or into that of the works preserved at the depôt of the establishment.

Formerly, the greater part of the engineer officers of the British army arrived at the rank of captain, without ever having seen a gabion or a fascine either made or fixed in its destination; but at present their practical instruction is as much attended to as it was before neglected. They are all obliged to commit to writing papers upon the practical works which the artificers at Chatham execute with all imaginable correctness; and lastly, in that school of exercises, officers are the only instructors both of the non-commissioned officers and soldiers.

Having thus given the reader an idea of the important engineer school at Chatham, I proceed to some notice of the royal military repository at Woolwich; a special department which may be considered in two points of view, both as a collection of models, and a practical school for the manœuvres of artillery.

It was in 1775 that the first attempt was made to collect models of guns, carriages, caissons, ammunition tumbrils, and machines of every kind necessary in the artillery service. They were at first placed within the limits of the arsenal, and, by the care of the late General Congreve, a beautiful collection was effected, which was however unfortunately destroyed, some years ago, by a fire. After the death of General Congreve, his son, who introduced the rocket into the British service, first as an expedient to fire buildings, and then as a propelling force for warlike projectiles, has had charge of the repository, and commenced a collection of models, which is at present far from complete. I remarked in the present model room, which has been chosen temporarily in the arsenal, models of the towers that were built on the British coast at the epoch when an invasion from France was apprehended There were, besides, models of a great number

of gun-carriages, more or less extraordinary in their construction, but, generally speaking, not very many objects worthy of attention.

In 1819, the building of a spacious rotunda, having the shape of a Chinese kiosk, was commenced on one of the hills above Woolwich, and near the great artillery barracks. The edifice contains a circular hall of about forty yards diameter, which is intended for the seat of the repository of models. It is near this rotunda that the extensive and fine exercising ground is situated, which is destined for the manœuvres of the school of the repository. It is encircled by a ditch, defended on its interior crest by a line of chevaux-de-frise. The interior of this great park presents, among the features of the ground, varied combinations of slopes, which are extremely well calculated to afford the non-commissioned officers and soldiers of artillery every opportunity of practice in all the manœuvres to which garrison or field-service can give rise. Within the enclosure have been constructed different fortifications and batteries, armed with every description of ordnance, on field, garrison, and sea-coast carriages. In the most elevated parts of the park sheds have been built, under which a pretty large variety of models of ordnance has been collected.

Advancing towards the bank of the Thames, you pass hills, vallies, a river, a lake, an island, &c. with narrow, difficult, crooked roads, crossing defiles and ravines. Thus this field of exercise seems to afford every local contingency which warfare usually produces. It would seem that no situation ought to embarrass artillerymen who had thoroughly gone over the manœuvres of the practical school. On the esplanade in front of the barracks they are made to perform their evolutions with light field-pieces; on the proving ground they are taught to fire with precision; and lastly, in the interior of the ground of the repository, they are practised in the performance of manœuvres of strength and exertion for every occasion which can arise.

In 1812, the personnel attached to the repository was composed of

1 Superintendent.	2 Lieutenant-secretaries.
1 Modeller.	10 Serjeants.
1 Draftsman and Clerk.	4 Workmen.

The serjeants, here mentioned, are the individuals who teach the artillery manœuvres. To give an adequate impression of the importance of the establishment, it may be sufficient to cite the heads of the subjects of four lessons, as

quoted in the "Sixteenth Report of Military Inquiry."

First Lesson, 13th August, 1810.

Present: four lieutenants, thirty-nine non-commissioned officers, 264 gunners.

Manœuvring of garrison ordnance, including mortars; splicing and knotting of cordage; making rammers; practice with red hot shot. Crossing ditches; mounting and dismounting guns without the aid of a gin. Heavy field-artillery; embarking and disembarking field-artillery on and from rafts; mounting and dismounting whale boats on and from pontoon carriages; throwing a bridge of sheet iron pontoons over a river, &c.

Second Lesson, 14th August.

Present: two lieutenant-colonels, one major, one captain, three lieutenants, forty-four non-commissioned officers, 264 gunners.

Garrison cannon and mortars; packing of ammunition; cutting and adjusting fuses; diagonal scale. Use of mantelets; mounting and dismounting heavy field-artillery, without gins; mounting and dismounting iron pontoons; laying a bridge for artillery to pass from one hill to another; manœuvring of heavy artillery in passing ditches, &c.

THIRD LESSON: 15th August.

Present: one lieutenant-colonel, three lieutenants, thirty-five non-commissioned officers, 250 gunners.

Garrison cannon and mortars; Gibraltar gin; inclined plane for twelve-pounders; shifting bridge; packing of ammunition; carrying off guns by disengaging them from their carriages, when the latter have been disabled; transport of guns on rollers; mounting and dismounting iron pontoons; embarking field-artillery on rafts; &c.

FOURTH LESSON, 17th August.

Present: one lieutenant-general, superintendant, one major, one captain, five lieutenants, sixty non-commissioned officers, 534 gunners.

Garrison cannon and mortars; gins, manœuvres of carriages, devils, &c. for carrying platforms, &c.; bridges of metallic pontoons, and small carriages; splicing of cordage; escalading of walls; carrying off from the field of battle, a gun whose carriage has been disabled, &c.

From the detail of lessons which we have here given, it appears that there is no methodical system followed in the instruction of the non-commissioned officers and soldiers of artil-

lery; but a sufficient idea may be formed of the extent of the practical information which they are made to acquire. A detestable esprit de corps, as strong in England as on the continent, has prevented Sir William Congreve, who is director of the department of the repository for the artillery, from being regarded as appertaining to that arm in other respects; and therefore he can have no officers of artillery under his orders. The consequence is, that the instruction of which we have been speaking, is necessarily confided to mere serjeants; and that, on such a badly organized system, the officers of artillery, present at the lessons of the school, think it sufficient to march their companies to the spot where they are to be instructed in the manœuvres, without themselves sharing in any part of them; being inactive spectators only, they naturally take but very slight interest in the progress of the operations, or the success of the instruction. The engineer school at Chatham is conducted, as we have seen, on a system of infinitely superior character and arrangement.

CHAPTER IV.

Royal Academy for the Artillery and Engineers.

It was in the year 1741, that the Royal Military Academy of Woolwich was created by a special warrant of George the Second, for the instruction of youths destined to become officers of engineers and artillery. At that epoch, the annual expense of the establishment was about five hundred pounds sterling; in 1819, the charge upon the public for the same purpose amounted to £7,568 : 10*s*. Some idea may be formed of the increase of this institution from the following statement of the number of pupils in the academy at different years from 1776 to the middle of the last war.

In 1776	48 Cadet pupils.	In 1796	90 Cadet pupils
1786	60 Ditto.	1806	188 Ditto.

The academy at Woolwich, like the Military College, is divided into two schools; the first, appropriated to pupils of the youngest age, the second, to those more advanced. The latter is, properly speaking, the only part of the institution which can be considered as a special professional school.

The master-general of the ordnance is the titular governor of the academy; but the choice of candidates to fill the civil and military situations in that establishment, and nomination to cadetships, are almost the only functions which the governor exercises of himself. Since the period when the Duke of Richmond took the command of the ordnance, the appointment of cadets to the rank of officers, in lieu of being at the caprice of the governor, is bestowed after a public examination in presence of general officers named by the master-general. This wise practice was abandoned in the early part of the wars of the French revolution; but as soon as the academy at Woolwich had received augmentations capable of answering the demands of the service, the choice by examination was immediately reverted to, as the only mode of closing the door against favoritism, and maintaining a general emulation among the competitors. The pupils at Woolwich do not choose the arm in which they are to serve until they have completely finished their studies, and acquired a sufficient insight into the career which they are to embrace irrevocably.* At

* The author is under a misapprehension upon this point; the pupils of the academy at Woolwich do not choose for themselves between the engineer and artillery services. The

the French school of Metz also, the same plan should be followed of only requiring the youths educated there to choose between the artillery and engineers after they have studied the acquirements and information necessary for both branches of the service, in themselves so mutually dependent upon each other.

The professors at Woolwich are, like the cadets, named by the master-general, after a public examination of all the candidates, made in his presence by learned men of celebrity. The geometrician Landen, and the astronomer Maskelyne, acted for a long time as examiners in this manner.

The academy is under the immediate direction of a lieutenant-governor, whose situation is held for life, or, at least, very nearly so; and it is filled alternately by a field-officer of engineers, and one of artillery. The post is at present confided to the enlightened superintendance of Major-General William Mudge, member of the Royal Society of London, correspondent of

former is naturally the object of preference and ambition, as it is the best paid, and highest in distinction of the corps of the ordnance; those, therefore, of the young men are selected for the engineers who, on the completion of their education, appear by their attainments to be best qualified for such appointment.—*Tr.*

the Royal Institute of France, and director of the Trigonometrical Survey of Great Britain.*

The inspector and sub-inspector of the Academy watch over the studies and discipline, the first of the upper school, the other of the under one. These two places are given to engineer and artillery officers.

The following was the establishment of the Royal Military Academy at Woolwich in 1815:

	£.	s.	d.
1 Lieutenant-Governor	300	0	0
1 Inspector	569	7	6
1 Assistant	172	16	3
1 Professor of Fortification	494	0	0
2 Assistants	599	0	0
1 Professor of Mathematics	435	4	0
5 Masters of do.	1,703	10	0
1 Assistant	247	0	0
2 French Masters	532	6	0
1 Master of Military Drawing	279	0	0
1 Assistant	237	0	0
1 Drawing-Master for Figures	241	4	0
1 Do. for Landscape	265	7	0
1 Master of Fencing	178	4	0
1 Do. of Dancing	121	16	0
2 Clerks	227	15	0
2 Modellers	207	7	6
Total	6,810	17	3

* General Mudge is since dead, and has been succeeded in the lieutenant-governorship of the academy by Colonel Ford of the engineers; while Captain Colby of the same corps, a gentleman well known in the scientific world, has been appointed to the direction of the great trigonometrical survey of England, the early operations and progress of which General Mudge long so ably conducted.—*Tr.*

The pupils for the academy are chosen among the sons of the nobility, gentry, and corps of officers of the service; and are received between the ages of fourteen and sixteen years. They are first entered into the under school, and, at the end of a year, are examined in the first elements of the mathematics.—If they acquit themselves in a satisfactory manner in this trial, they are then placed in the upper academy, where they proceed to the completion of their education. The cadets are officered from the artillery, and divided into companies.

For each cadet, and during the whole time of his residence at the academy, the state pays half a crown per diem.—This sum,* which is a

* The following is the manner in which this sum is employed:

	£.	s.	d.
Clothing, 6*d.* per diem	9	2	6
Board, 1*s.* 1*d.* per diem, 295 Days	15	19	7
Washing and Haircutting	4	10	0
Servants, 8*s.* a quarter	1	12	0
Serjeant-Instructor in Exercises, per annum	0	1	0
Pocket-Money, per week 1*s.* 6*d.* for 42 Weeks	3	3	0
Charge of Agency	0	7	7½
Books, Sundries, &c. &c.	10	16	9½
Total annual expense equal to the Pay	45	12	6

On entering the institution, the pupil must deposit towards the expenses, once for all, of the first charge for uniform, books, instruments, &c. fourteen guineas in the chest of the academy.—*Author.*

very moderate one in England, is sufficient for the entire support of the pupil, on whose account his parents are at no expense whatever. This paternal arrangement recals to our mind the primitive organization of the polytechnic school, by which the pupils received pay as serjeants of artillery, with a further provision to the least opulent of the number, on a simple certificate from the municipal authorities of the residence of their parents, that such aid was requisite.

The Military Academy was formerly wholly situated in the artillery arsenal at Woolwich; but the old accommodations being found insufficient when the establishment received augmentations, they were reserved for the elementary division, and a large edifice erected for the upper school, which is equally remarkable for its structure and position. Built on the slope of a hill, and in rear of an extensive esplanade, it presents one of the most beautiful points of view which the environs of London, and the banks of the Thames, can offer. On a parallel line, and on the opposite side of the esplanade commanded by the new academy, are seen the barracks of the ordnance, which occupy all the length of that side, and contain quarters for two thousand men, with the horses of the field-train and light artillery. These barracks crown the

summit of a declivity, which, sweeping in its descent to the arsenals of the artillery and navy, gives the form of an amphitheatre to the town of Woolwich. A third side of the esplanade is terminated by a range of houses for the principal professors, and the hospital of the academy; and, lastly, on the side facing London, are placed a park of field-artillery, the enclosure of the repository, the rotunda for models, and, a little farther, a row of small buildings detached from one another, but of similar construction, and equally modest in appearance and interesting in their object, as set apart for the families of married non-commissioned officers and soldiers. It is thus that respect for manners, and the desire of softening the privations inseparable from military life, have urged the public authorities of England to the execution of a number of paternal measures, which can only be blamed as sometimes carried to too great an extent, but always undertaken with the most laudable motives.

The heights by which Woolwich is immediately surmounted, and which prolong themselves in ranges of successively greater command, present by far too extensive a tract of country to be encircled by respectable fortifications: it has, therefore, been preferred to erect no works at all, rather than to incur expenses

which are always extravagant when they are entered into for the construction of insignificant fortifications. It is at the passage across the Channel; it is between Boulogne and Dover; it is at the mouth of the Thames; and on the banks of the Medway, that Woolwich, Deptford, Greenwich, and London itself, must be defended. The security enjoyed by the English for their military establishments, has allowed them to choose waste lands, beyond the walls of cities, and in fine situations, where there is space for the erection of regular edifices, divided by extensive courts, ranged about large squares, sheltered by beautiful woods; in short, where may be united, with scarcely any other expense than that of purchasing a well-chosen site, all that can contribute to the comfort, the health, and the enjoyment of life. Generally speaking, the English have sought no decoration for this species of architecture but that afforded by appropriate ground, and a style of building at once regular and extremely simple: yet the symmetry and vast extent of such edifices awaken in the mind of the spectator who studies them, those ideas of order and majesty, of wisdom and power, which the sight of grand works, undertaken without a vain love of ornament, and solely for public utility, must never fail to excite.

The first stone of the new academy for artillery and engineer officers was laid in May, 1803, by the Duke of York, as commander-in chief of the British forces. In the month of August, 1806, the building was finished and ready for the reception of the pupils, who were removed to it at that period. Here, as in many other establishments, the Gothic, or rather Arabesque architecture, was selected, in preference to the Grecian or modern. Walls concealing the lower parts of the roof-work, and crowned by lofty battlements, square towers raised at every angle, and commanding the rest of the edifice; galleries formed by light pillars supporting elliptical arches, which present an obtuse angle at their centre; casements and doors surmounted by arches of the same shape; all these give to the academy of Woolwich an antique and venerable air. Westminster-school, the colleges at Oxford, and those at Cambridge, have for the most part the same character. In a country, where existing liberty and modern greatness are fruits of the laws of antiquity, it is conceived that, by educating youth among the monuments of former days, they may be taught to venerate the labors of past generations, and to cherish, to preserve the constitution, the manners and the customs, which, by their excellence, have triumphed over time and events.

The pupils of the Military Academy are lodged in small rooms, each containing four persons; these rooms are situated in two buildings placed in the wings of the academy. They eat all together, in a large and handsome dining-hall; and, when under illness, are taken to an infirmary, where their cure is confided to the first surgeons of the artillery. They are in such case treated with all the attention, all the care, which opulence and humanity can bestow. Several pieces of field-artillery, used in the manœuvres learnt by the cadets, are ranged in front of the buildings, to which they give a military air. In the interior there are halls appropriated to the different classes or companies, decorated with the firelocks of the cadets, and maintained in a perfect state of cleanliness.—There is also a hall for the instruction of every class, and where the pupils have each their table, desk, and drawer, under lock and key; the tables are too small for drawing a plan of tolerable size upon them. A small but pretty semicircular amphitheatre is set apart for lectures on chemistry and natural philosophy; behind the professor's desk are stoves ranged in a straight line.—The amphitheatre is lit entirely by a glass cylinder, immediately over the head of the professor. By means of a cord passing through a pulley at the summit of the lantern

formed by this cylinder, a circular frame, perfectly opaque, and of the same diameter as the cylinder, descends over it to the roof of the theatre, and adjusts itself there hermetically, so that the lecture-room becomes perfectly dark, and, consequently, properly adapted for particular experiments.

At the academy are taught the mathematics, a little natural philosophy and chemistry, fortification, drawing of every kind, French, fencing, and dancing. There are six professors of mathematics, besides assistants; and the course followed at the institution is that expressly compiled for the purpose by the celebrated Hutton. This course at first contained only the elements of arithmetic, algebra, and geometry; plane trigonometry, the elements of mechanics, with some of their applications to artillery, the exposition of the method of fluxions, and fluents, &c.; and all this in two volumes of moderate thickness. Since, however, General Mudge became lieutenant-governor of the academy, he has directed his attention to the means of giving more depth and extent to the course of instruction; and the production of a third volume of mathematics has been the result.—Doctor Hutton, in concert with Doctor Gregory, is the compiler of this third part of the course, which contains the theory of conic sec-

tions, spherical trigonometry, the solution of a great number of mechanical problems, the application of geometry to the arts, &c. &c. It may be seen, therefore, that it adds considerably to the instruction of the pupils, and the only objection that can be made to the third volume is, that it is composed more of patch-work pieces than of a systematic course; a defect which we ought, however, to ascribe to the great age of its estimable author, who, having been necessitated to avail himself of the aid of another, appears to have allotted the task of both at hazard, without commencing on a regular plan.

The instruction in natural philosophy and chemistry appears to be very much circumscribed; for the pupils are not exercised in making experiments themselves, as in the Polytechnic School, and, without this, every one is aware, that there can be no solidity in chemical studies. The school at Woolwich possesses a very poor cabinet of physics; it contains scarcely any thing but a small air-pump, an old electrical machine, a hydrostatic balance, a fine machine by Atwood, for showing the laws of acceleration of the fall of heavy bodies; good thermometers and barometers, both portable and otherwise, well calculated for military officers; and, lastly, a few models of regular solids.

The elements of fortification taught at the Academy are extracted from French works on the subject, and exemplified in a model of Vauban's system in relief, with all the operations of attack and defence, the works of mines, &c. Vauban and Carnot are the authors whose writings on fortification, and systems, are in most estimation in Great Britain. The British, though jealous to excess of their proper claims to glory, have had the wisdom to study and profit by the labors of other nations. They render entire justice to our treatises upon the military art, and even upon the marine; it is doubtless on this account that they have, in the greater number of their public academies for the land and sea service, masters of the French language; and Frenchmen as professors of the military sciences.* The elementary writings published on artillery, fortification, and mines,

* The author is certainly justified in his implied assertion, that we are indebted to his countrymen for our first acquaintance with the scientific branches of the profession of arms; and much good sense has doubtless been evinced in the use of French authors and French instructors upon such subjects in our military institutions. We are now, however, at least on a par with our old masters in military science, and may carry our submission to foreign tuition a little too far. There can be no question that, in the British service, every department of the art of war has attained so high a degree of excellence as to have formed numerous native officers, with the fullest qualifi-

for the instruction of the cadets, are mere compilations, and not deserving of any notice.

There is at the Academy a small workshop for the fabrication of models and machines, necessary in the demonstration of the different courses. The fortification models of the Academy form an interesting collection. I remarked, in particular, a model of Gibraltar, of perfect execution, and on a very large scale. The point of that fortress, which was formerly considered as the most assailable, is now become the strongest, by the erection of an immense casemated bastion, bristled with cannon, like the battery of a first-rate vessel of war. Since the period when this was constructed, other works have also been added in all parts, and particularly towards the west. Steep rocks, at right angles to the line of approach towards the fortress by land, have been excavated, in order to lodge artillery in them, for flank defence; and, altogether, it would now seem utterly impracticable to attack that side with success. I likewise observed among the models one of a star-fort, according to

cations for instructors in all the great divisions of military knowledge, in fortification, in the art of surveying and laying down a country for military purposes, and in artillery, as well as in the more mechanical and less intellectual business of tactical detail.—*Tr.*

Montalembert, destined for Portsmouth in the war of 1778, when the combined fleets of France and Spain threatened the coasts of England with invasion. This fort ought certainly to have been constructed in advance of Gosport, on the commanding position pointed out by Lloyd as proper to cover the western approach to Portsmouth, and to protect the magnificent naval and ordnance establishments. Notwithstanding the importance of that position, and the pressure of events, the project was found likely to be so expensive, that the Parliament refused the funds for the undertaking.

These are the principal objects of attention in the model room; but to return to our statement of the course of instruction at Woolwich,—the pupils are taught to draw figures and landscape, to trace and execute plans of fortification, maps, sketches of reconnaissance, &c.; and when they have finished this part of their education, they are made to carry on their operations from nature. Bases are given to them to measure on the heights above Woolwich; and they are afterwards charged with the task of executing partial sketches of surveys of the surrounding country, by the aid of the best instruments for taking off angles.

Dancing and fencing are also taught to all

the pupils, either as gymnastic exercises, or to give the officers less awkwardness in their carriage, and more confidence in their air. It is besides requisite that every military man should know how to use his arms, in case of his being thrown, particularly in a corps performing detached duties like the artillery, hand to hand among the enemy.

The cadets have two vacations in the year; one of fifteen days only at Easter, and another, which terminates the scholastic year, of six weeks at Christmas. A little before this latter period, the examination of the pupils is entered into; it is carried on partly in writing, and partly *vivâ voce*. The cadets are ranged in order of talent and conduct, and the first of these qualifications determined by their place in the different branches of science, according to the relative importance of each.

The Military Academy of Woolwich has, like the French polytechnic school, although with less splendor and extent, rendered important services to the general cause of mathematics and natural philosophy. Its professors have always been distinguished by their talents, and celebrated by their works. Simpson was long mathematical professor there; and his successor Hutton, with inferior powers in the treatment of questions purely theoretical, has distinguish-

ed himself by happiness of application of such questions, particularly to the ballistic pendulum. Finally, Bonnycastle, Barlow, Gregory, &c. have propagated knowledge in their elementary writings, which had been previously too much neglected in England. These learned and laborious men have contributed, in our days, to revive the honor and promote the cultivation of the exact sciences, which appeared for a length of time almost abandoned on the spot where Barrow, Wallis, Cotes, Taylor, Maclaurin, and the great Newton, had erected immortal monuments of mathematical philosophy.

BOOK IX.

EXERCISES AND SMALL ARMS.

CHAPTER I.

Of Exercises in General—Cavalry—Infantry.

THE British government published official regulations for the infantry in 1792, and in 1796 for the cavalry, in order to give precision and uniformity to all the manœuvres which it would be necessary to adopt in these services in actual warfare. The system established in the Prussian armies by the great Frederic was followed, almost literally, in both cases.

The general principles of the management of arms, of the formation in order of columns or lines of battle, and of the change of those orders, are the same in the tactics alluded to, and in the plan pursued in the French army. Some differences in detail, arising from movements, more or less rapid, more or less simple in execu-

tion, are observable between them; but, in general, they are extremely analogous. In fact, the great points of dissimilitude in the tactical science of the nations of modern Europe, are founded neither upon diversity of principle nor particular mode of execution, so much as upon the genius for their application by general officers, upon the character, bravery, and proportion of the different forces of which armies are composed, and upon the nature of the country forming the theatre of war. It is for experienced officers, therefore, who have made campaigns against the British troops, and had opportunities of observing them closely during their period of remaining in France, to afford us information upon this interesting subject.* It enters only into the plan of this work, (and we shall limit ourselves accordingly,) to consider the valor, strength, activity, and resistance to fatigue, evinced by the British soldiery of each arm; the nature of the arms which they employ, and the use which they have made of these arms. We have treated of the moral

* General Foy has commenced this great and interesting work for the wars of Spain and Portugal; let us hope that he will find leisure to complete his undertaking, and afford us, like another Lloyd, a picture of the progress of the military art, during this new war of seven years.—*Author.*

force of the English army in the seventh book; in the eighth, while speaking of the practical schools of the ordnance, we have entered much at large into details of the studies and exercises of the officers, non-commissioned officers, and soldiers of the engineers and artillery; and we shall recur to the same subject in the following books. The first chapter of the present book we shall devote to some observations on the march and management of weapons of the troops using small arms in action. The remaining chapters will treat of the manufacture, proof, and supply of those arms, and of powder and rockets.

Never having served in the cavalry, and having enjoyed no opportunity of witnessing the exercises of that arm in the British service, I shall not attempt any description of the mode in which recruits in dragoon regiments are trained; and shall be content with remarking, that the English trooper is usually much more expert in the management of his horse than in the use of his arms, and particularly of the sabre. It is not long since the present sword exercise for the cavalry first introduced the use of the sabre in an uniform, regular, and general manner.

For the exercise of fire-arms, there are issued

annually to every corps of cavalry, for each pistol or carabine,

Spring exercise .	10 rounds of ball cartridge 30 ditto of blank ditto 2 flints.
Autumnal exercises	20 rounds of blank cartridge 1 flint.

The British cavalry are provided in fire-arms with the carabine and pistol; the following comparative table will show how these arms differ in dimension from those used in the French armies during the late war. The numbers are given in inches and tenths, and ounces and tenths.

	CARABINE.		PISTOL.		
	English.	*French.*	*English.*	*French.*	
Length of the barrel .	36.015	29.83 .	14.	7.9	Inches, &c.
Diameter of the bore .	.61	.673 .	.58	.673	
Diameter of the ball .	.60	.653 .	.51	.653	
Weight of the ball .	.795	.959 .	.456	.795	Oz. &c.
Weight of the powder	.25	.432 .	.187	.28	

To compare the swiftness, and force of attack and resistance of cavalry, infantry, and artillery, a series of very interesting experiments were made in London in 1802, which might be repeated with advantage in France. Cavalry were made to charge, according to the usual rules, against artillery and infantry remaining

firm and stationary, and receiving their charge with a constant fire. The periods occupied in passing over the ground of the charge were calculated, with the different degrees of swiftness exerted throughout the charge, and the number of rounds that were fired before the cavalry had traversed the length of the attack. The results were as follow:

A soldier of light cavalry setting out, at 600 yards distance from the battery designated, completed the advance to it in the following paces, and numbers of seconds.

	Walk—*Halt.*	Trot—*Halt.*	Gallop—*Halt.*	Charge—*Halt.*	*Total.*
Yards	200	150	170	80	600
Seconds	95	28	13	8	144

Which gives a space per second of—

	At the Walk.	*Trot.*	*Gallop.*	*Charge.*
Yards . .	2.1	5.36	13.08	10

The same trooper, completing this distance without halting at each change of pace, performed it in 115 seconds in lieu of 144. During this time the artillerymen, who served a six-pounder gun, upon which the horseman charged, fired thirteen times.

Experiments were then made with a view to

the attack of cavalry upon infantry. The trooper, setting off at 400 yards distance, went over the ground at an accelerated pace in forty-nine seconds; during which time three rounds of musquetry were fired. It was then shown that a corps of cavalry, arriving within eighty-seven yards of a body of infantry, then making a feint of retiring, receiving the complete volley of the enemy, wheeling about again, and advancing at full gallop, would be among the infantry before they had had time to re-load.*

It appears to us that these experiments, which were extended also to the charges of infantry against infantry, the defendants remaining stationary, and against artillery, are worth the attention of military men, and might supply them with important principles with regard to the kind of attack to be most decisive if successful, and most disastrous if it fail.

* The majority of military readers will attach less weight than the author has done to the experiments in question; and the possibility of inducing cavalry *to make a feint of retiring* to receive the volley of their opponents when within eighty yards of a square of infantry, only for the purpose of overwhelming them by an immediate return to the charge, will be regarded with a scepticism fairly warranted by experience.—*Tr.*

In 1802, the officers of British artillery made experiments on the efficacy of grape-shot from field-artillery against cavalry and infantry. For this purpose they erected a target, about thirty yards long, and eight feet high, to represent cavalry, and another having the same length by six feet in height, for the semblance of infantry. The number of balls fired, and the proportion which entered the targets at different ranges, are given in the subjoined table:—

Distance of the Piece from the Target.	*Nature of the Charge.*	*Elevation of the Gun. Degrees.*	*Target representing, Cavalry.*	*Infantry.*
500 yards	12 balls of 8 oz. each, 3 per row; 20 oz. of powder	1	3	3
		1½	4	3
		2	4	3
400 yards	The same charge.	1	6	6
		1½	5	4
		2	5	4
300 yards	The same charge.	·½	7	6
		1	3	3
		1½	6	4
400 yards	34 balls of 3 oz. each, 7 in a row; 24 oz. of powder	P.B.	12	10
		·½	10	9
		1	18	6
300 yards	The same charge.	P.B.	13	11
		·½	15	12
		1	9	7

In proceeding to speak of the exercises of the English infantry, we have to offer some results, with respect to their mode of marching, which may be useful.

COMPARATIVE MARCH OF TROOPS.

	French.	English.
Ordinary time,		
Length, in inches, of the pace	25·6	30
Number of paces in a minute	76	75
Space completed,		
Number of feet in a minute	162·133	187·5
Ditto, in an hour	9728·	11250·
Quick time,		
Length, in inches, of the pace	25·6	30
Number of paces in a minute	100	108
Space completed,		
Number of feet in a minute	213.33	270
Ditto, in an hour	12800	16200

It is impossible not to be struck with the superior activity here visible in the cadenced step of the British over that corresponding to it in the French service.

The oblique step, much less important, however, than those above enumerated, gives quite a contrary sum of distance performed.

COMPARISON OF THE OBLIQUE MARCH OF TROOPS.

	French. Inches.	English. Inches.
Length of two paces		
Parallel to the line of battle	18.1	13
Perpendicular to that line	36.2	26
Obliquely	40.75	28.8
Number of paces in a minute	76	75
Space completed in a minute	*Feet.*	*Feet.*
Parallel to the line of battle	106.3	81.25
Perpendicular to that line	212.6	162.5
Obliquely	258.	180

It appears, then, from the calculations which we have entered into, that the French and British troops in the different steps would complete distances in a given time, according to the following ratio:

Troops.	*French.*	*English.*
Ordinary time	100	116
Quick time	100	142
Oblique step	100	70

I remarked, in the exercises of the British, a side step, which was, I believe, first employed by the great Frederic, and serves to close in platoons, and even battalions, to the right or left, without the corps so moving facing from their front for the purpose, or occasioning the usual inconvenience of a formal flank movement.

In spots destined for the exercises of recruits, the precise length of the different species of pace is carefully marked off on the ground, in order to accustom the soldier always to complete the same distance in the same number of paces. Such care, indeed, is bestowed upon the regularity of movement of the soldier, that I have seen recruits taught to march, in the depôts in England, by marking the time to the motion of a pendulum, that mathematical accuracy might be ensured. The following are the lengths of pendulums, whose motion corres-

ponds to the time allowed for each description of pace.*

			Inches.
Ordinary time . .	75 paces per minute	. .	25.039
Quick time . . .	108 ditto ditto	. .	12.086
Double quick . .	120 ditto ditto	. .	9.76

A musket-ball, suspended from a string which is not liable to stretch, and on which the division of paces, according to the length of pendulum, corresponding to their cadence, is accurately marked, may always be provided with ease. These lines, however, should be frequently compared with the standard kept by the adjutant or serjeant-major. The length of pendulum is measured from the point of suspension of the string, to the centre of the diameter of the ball.

At the fort at Sunderland, I saw an apparatus of very careful construction for marking time; it consisted of a small square platform, resting on the summit of an upright, which had its lower end fastened into another platform of ra-

* The lengths here given deviate a little from those prescribed by regulation, which are not very exact. It is known that in places which differ in latitude, the length of the pendulum beating seconds must vary. But as long as the difference in latitude is not very great, the variation is too inconsiderable to deserve notice, in fixing the pendulum for the cadenced step of the soldier.—*Author.*

ther larger dimensions; this last could be fixed perfectly to a horizontal level on the ground, by means of an adjusting screw. On the edges of the upper platform are fixed the lines of suspension of three pendulums, marking respectively the ordinary, quick, and double quick time.

It might, perhaps, excite a smile of pity in some military men, to see this simple scientific apparatus supersede the ruder contrivance of the word of command, *left—right*, of a serjeant or corporal. But, if it be at all necessary that troops should learn to march with exactitude, why should not that be regarded as the best means, which attains the object desired with the greatest correctness? If you use the chronometer in instructing your musicians, why not have recourse to the same instrument in the training of those soldiers, for whom you thus form your musicians?*

The rules for the exercises of the British in-

* The pendulum seen by the author at Sunderland appears to have been only that commonly used in our service; where the importance of uniformity of time in military movements, to ensure exactness of combination for operations on the great scale, is perfectly understood; and proper attention bestowed upon the attainment of the correctness demanded by general regulation. It would seem, however, that this is a point less regarded among the French military, from the tenor of the author's remarks.—*Tr.*

fantry, strictly forbid the practice of regulating the march of troops during their manœuvres, by beat of drum or music. It is only permitted to have five or six loud preparatory strokes upon the drum, beaten just before the word of command is uttered, to mark the time, of whatever step the troops are about to move in. The men, having thus received an impression of the cadence of the time in which they are to march, are found to step with more harmony and ease. It is regarded as highly essential that the band, drums, and fifes of a regiment be not suffered to deviate in the slightest degree, when playing, from the time fixed for making the proper number of paces in a minute. By regulation, therefore, the drum-major must practise the musicians in the movements of the ordinary and quick time, by means of the pendulum, until they have acquired the precise cadence prescribed for the march. Lastly, the music* and drums are frequently exercised together, in order that, when they play alternately, there may be no change in the time.

The position of the English soldier under arms

* The band of a regiment is composed of men taken from the different companies, with a master, rated as serjeant. The musicians, however, are required to be instructed in their duty as soldiers, and prepared to serve in the ranks in case of need.—*Author.*

appears to me to be less irksome and constrained than that of the French; he is less thrown forward in his posture, his elbows hang more freely, he carries his musquet in a manner less fatiguing to the arm.* These remarks are, it is true, upon minutiæ, but they have, also, relation to points of the utmost importance, for preserving that health and strength in recruits, which the French lengthened exercises tend rather to destroy than encourage.

At present, while the knapsacks are made as flat as possible, the centre of gravity of the soldier, and of his equipment, is naturally thrown less backward than formerly, and there is, consequently, less necessity for leaning the body so much to the front. The knapsack, from being made up to a less degree of thickness, has the advantage of diminishing the intervals between the ranks, and of enabling the firelocks of the second and third ranks to project accord-

* At carried arms, for instance, we cause the but-end of the firelock to be borne so much in rear, that the least movement is sufficient to throw the musquet forward, out of the shoulder, a circumstance which frequently occurs with the French recruit. The arm which carries the musquet is, also, too much bent, and the weight of the piece thus rendered the more uneasy. In the same position of the English soldier, the barrel of the firelock is rather thrown back, so as to rest more easily on the shoulder.—*Author.*

ingly farther in advance.* Lines of infantry can thus give a better fire, and present a more formidable solidity for either attack or defence with the bayonet.

"The fundamental order of the infantry, in which they should always form and act, and for which all their various operations and movements are calculated, (say the British official regulations,) is in three ranks; the formation in two ranks is to be regarded as an occasional exception, that may be made from it, where an extended and covered front is to be occupied, or where an irregular enemy, who deals only in fire, is to be opposed. But from the present low establishment of our battalions, (1792) they are during the time of peace permitted, in order to give the more extent of front in their operations, to continue to form and use it, in many of their movements and firings, at the same time not omitting frequently to practise them in three ranks."

"The formation in two ranks, and at open files, is calculated only for light troops in the attack and pursuit of a timid enemy, but not for making an impression on an opposite regu-

* By regulation the English soldier occupies a space of 22 inches in the ranks; and the distance between the ranks is 30 inches, which becomes less when in the act of firing.—*Author.*

lar line, which vigorously assails, or resists. No general could manage a considerable army, if formed and extended in this manner. The great science and object of movement being to act with superiority on chosen points, it is never the intention of an able commander to have all his men at the same time in action; he means by skill and manœuvre to attack a partial part, and to bring the many to act against the few; this cannot be accomplished by any body at open files, and two deep. A line formed in this manner would never be brought to make or to stand an attack with bayonets, nor could it have any prospect of resisting the charge of a determined cavalry. In no service is the fire and consistency of the third rank given up; it serves to fill up the vacancies made in the others in action; without it the battalion would soon be in a single rank."

Notwithstanding the precision of the orders which we have here quoted, the British infantry, in many circumstances, manœuvre and engage in two ranks.* So slight an order of

* The author might have stated, not only "in many circumstances," but, under all circumstances: for we believe it would be difficult to give an exception to the custom of forming two deep in our service during the Peninsular war. Yet it is incorrect to ascribe it, as he proceeds to do, as arising from the

formation, which appears demanded by the numerical weakness of the English regiments, can only be justified by the excellence of their fire.* This excellence may be ascribed to three causes, the frequency and the perfection of their exercise, and the goodness of their ammunition.

By a general regulation, all the corps of infantry of the line, militia, and riflemen receive two-thirds on the 20th of March, and one-third on the 20th of September, in each year, of the following quantity of ammunition:

numerical weakness of battalions, which had very commonly (actually in the field) from 600 to 800 bayonets, a strength quite sufficient for a formation in three ranks, had such been thought desirable.—*Tr.*

* On this subject, General Rogniat thus expresses himself in his "Considérations sur l'Art de la Guerre." "The English must, like us, have observed that the fire of three ranks cannot be made unless the front rank kneels, and that this would be extremely dangerous in presence of an enemy, and besides leave the whole battalion exposed until the arms were recharged; that the firing by files, the only mode now practised in action, can be carried on by the two front ranks alone, and render a third rank almost useless; and finally, that in combat hand to hand, the bayonets of the third rank cannot project sufficiently in front of the first to be very effective. These are doubtless the observations of experience which, joined to the desire of extending their line to equal the front of a more numerous enemy, have induced the English to adopt the order of two ranks." Chap. VI. Ordre de la Légion, p. 191.—*Author.*

INFANTRY.	*Line and Militia.*	*Light Corps.*	*Riflemen.*
Ball cartridge, rounds	30	50	60
Blank cartridge, ditto	70	60	,,
Flints	3	3	,,

The materials are usually sent to regiments for making up ball cartridge; and to avoid every kind of accident, it is ordered, that blank cartridge shall be made up in blue paper, and ball cartridge with dark or light grey paper. The British are not satisfied with merely supplying their troops with the means of firing a great number of rounds for instruction, or to maintain them in practice. They use every exertion to render the fire of the soldier efficient; and, in place of expending nearly the whole of their powder in discharging vollies by platoon or battalion, where the sole object of the commanding officer is to cause the whole body to fire at the same moment, or to preserve a continued running volley, they rather endeavour to instruct the soldier in the true principles of firing, at a small, moderate, and great distance. He is frequently practised in shooting at a target; and it is an object never lost sight of, that the value of musquetry is not in the compactness or regularity of its sound, but in the murderous execution produced by steady aim. The English are indebted for most of their great victories to the

solidity of their infantry, and the rapidity and correctness of their fire.

The superiority in the fire of British infantry is far from being of recent date. "It is to be remarked," says General Duhesme (Essai sur l'Infanterie légère, historical notice on the battle of Fontenoy, p. 87.) "It is to be remarked, upon the subject of this terrific column of the British, that that nation were, *at the time*, very superior to us in their fire. They understood how to fire by divisions and battalions with admirable order and precision, and we had only a confused irregular discharge to oppose to them, in which the French soldier advanced from his place in the ranks to fire his musquet, and retired again to load it."

At the present day, the British are, with the French and the Russians, the troops which are most formidable for their fire of musquetry, as well as the charge of bayonets.

The English rifleman places the but of his piece between his heels when he charges it, the barrel passing between his knees, and, with his right hand draws the ramrod, which he forces down the barrel with both hands. The rest of the process of charging offers nothing remarkable. A bugle gives him the signal for commencing and ceasing to fire.

In discharging his rifle, the soldier places his

right foot at eighteen inches distance from the other, the left knee being bent, the body thrown forward, the head inclined to the piece, so that the cheek shall rest upon the but, the left eye closed, and the right fixed upon the sight of the rifle. As soon as he brings the object, at which he is to aim, in a line with the sight, he fires without awaiting the word of command. The rifleman is also practised in firing upright.

To exercise riflemen, they are first made to fire at a circular target of about five or six feet diameter, with colored circles to mark different distances from the centre. The target is first placed at about fifty yards from the men, and afterwards gradually removed farther and farther, until it is at about three hundred yards from them. But to proceed to more amplified details upon the service of the light infantry and rifle corps would be foreign to our plan. We conceive, however, that the English rules for these services, which were originally taken from a German work of high estimation, might be studied with advantage by the French military.

CHAPTER II.

Of the British Musquetry—Supply of Small Arms to the Troops.

The British musquetry is remarkable on many accounts, and we shall therefore make it the subject of particular enquiry.

The calibre of the English musquet is greater than that of the French; and, as the piece itself is shorter, it is not much more weighty. The calibre of this arm being thus superior, and equal to ours in other respects, it carries farther, notwithstanding its diminished length, than the French firelock. The shortening of the barrel will doubtless lessen the initial velocity of the projectile, but as this projectile is of larger volume, it loses its velocity much less rapidly: it preserves, for a longer time and to a greater distance, sufficient force to inflict dangerous wounds. Another advantage in short firelocks is, that they fatigue the soldier much less whilst holding them in an horizontal position, either to fire, or to charge bayonets.

The bayonet having an excess of length, compensating for the shortness of the musquet,

is not less advantageous than the French, when the united weapon is to decide the contest.

Musquets.	*English. Old Model.*	*French. Model of the Year 9.*
Length of the barrel, in inches	42	44·72
Diameter of the bore, do. . . .	·76	·69
Do. of the ball do. . . .	·681	·65
Weight of the ball for service, in drams avoirdupoise . . .	18·9	15·34
Do. do. for proof, do.	22·78	
Weight of the firelock with the bayonet, in pounds	11·91	10·98
Weight of the musquet is therefore equal to the weight of the ball multiplied by	163·15	183·23

The experience of warfare, and comparison with the arms of other nations, having convinced the English that they could make important improvements in their musquet, they have, since the late war, adopted another model, upon which they had, in 1817, already completed 80,000 firelocks. These new pieces are about two inches longer than those upon the old plan, and yet, by means of a mode of manufacture approaching to perfection, and of a better distribution of the metal, they are not heavier than formerly.

A spring, fastened into the socket of the bayonet, and pressing against the muzzle of the firelock, supersedes the complicated system of tenon and zig-zag mortice, which we use for the purpose of securing the bayonet on the firelock.

The wood-work of the musquet is more solid, and all parts of the locks are constructed with such uniformity, that, without need of alteration, they can be put together at any time for a new piece, or any damaged portion replaced by a fresh work in the same manner: the new musquet costs half a guinea more than upon the old model.

Besides the attention bestowed upon the musket itself, every expedient for increasing the effect of its fire is likewise sought by the British. A powder, manufactured upon particular principles, is reserved for military fire-arms, in the same manner as is done for fowling-pieces: this powder, being of finer grain, inflames more quickly, and, if equally excellent with any other in general quality, will give a greater initial velocity to the projectile.

The balls are cast and calibred with infinite care, and the cartridges are made up, both at the army, and in the arsenals, by persons expressly trained to the work, which they execute to perfection. The cartridge-paper, made for the purpose, is at once very strong and very fine. By this means the diameter of the cartridge is made up as little as possible by paper, and the ball can have the maximum of its weight in proportion to the calibre of the barrel,

a circumstance which has a prodigious influence upon the exactness of aim and range of fire.

The locks of the English musquets are of better workmanship than those hitherto manufactured by any other nation of Europe; they will less frequently miss fire upon a given number of rounds than all the rest.* This applies equally to the goodness of the fine powder used by the British for their small arms; this powder, which possesses great strength, burns without leaving either foulness or residue, that, by adhering to the lower part of the hammer, could fall among the priming and prevent it from taking fire. With the union of all these advantages, let us suppose an infantry, whose characteristic solidity and calmness have received the aid of discipline in rendering them immoveable; let us imagine them placed in such a position, as those always chosen for English lines, well situated by nature, and fortified by art—let such an infantry receive orders to await the attack of their enemy on the ground they occupy.—They commence their fire in two ranks as soon as the assailing columns, after having suffered all the fire of artillery converging upon them, arrive within the

* The English spherical powder does not miss fire with the English lock, but it will with that of the French.—*Author.*

good range of the English musquet.—Let us conceive the effects of fire maintained with a resolute calmness, which enables the soldier deliberately to load his arms, take steady aim, and use activity without haste: and we shall then form an idea of the power of an English line, even of two ranks only, at the moment most critical for its safety.*

The British, at the epoch of the siege of Gaëta, disembarked a body of troops on the coast of Naples, which General Regnier resolved to attack upon the spot, after making a forced march from his camp to the bay of St. Euphemia, for the purpose of engaging them. Led away by his anxiety to obtain a victory over a general, against whom he had experienced reverses in Egypt, he charged in column, and without firing, upon the English line; the enemy awaited him with firmness on their ground, and, at a proper range, commenced a fire, which, from its uninterrupted steadiness, occasioned us enormous loss. Regnier committed the fault of deploying his column under such a fire; the attempt threw our ranks into disorder, and the

* The author has here given liberal testimony to the steadiness of the British troops under attack; it is therefore fair to presume, that he would not hesitate to render the same justice to their qualities as assailants, in numerous instances which the events of the last war might abundantly supply.—*Tr.*

fate of the battle was decided. This was the first piece of brilliant success obtained upon the continent of Europe by the British, over the French infantry, since the commencement of the wars of the revolution; and it should, thenceforth, have been sufficient to prove that we had entertained a mistaken opinion of the intrinsic qualities of our enemy.

For several years the barrels of the musquets in the British service have been bronzed, both to spare the soldier the labor and annoyance of removing the rust, which daily formed upon the polished metal, and particularly to prevent the piece being too rapidly worn by continued and excessive friction in retaining it bright.*

* *Browning of Musquets.*—It is by instructions from the ordnance, and at the charge of that department, that the process of bronzing the metallic parts of musquets, as also of pistols, is carried on.—The following are the directions given for the purpose:

Take half an ounce of nitric acid, the same quantity of sweet spirits of nitre, and one ounce of spirits of wine, two ounces of blue vitriol, and one of tincture of steel:—mix all these ingredients, after having dissolved the vitriol in a quantity of water sufficient to make a quart of the whole preparation.

Before the barrels are browned, they must be well cleaned, a stopper of wood put into the muzzle, and the touch-hole closed: the mixture is then to be applied with a clean sponge or a rag, taking care that every part of the barrel is covered with the composition; after this the piece is to be exposed to the air for twenty-four hours, and then well rubbed with a hard brush, to remove the oxide which forms on the surface. It is necessary

This method of bronzing the firelock has the great advantage of preserving the piece, without exposing it to the daily friction formerly using in polishing it, a mode of cleaning, which necessarily removed part of the oxidized metal each time. Another advantage is, that bronzed arms can be discerned at a small distance only, while nothing is more distinguishable from afar than polished iron or steel. When a body of troops are on their march, a spectator, looking towards the direction in which they are approaching, can, if he has his back to the sun, distinguish in the air the scintillations of light produced by the polished metal of arms, long before it is possible to see the troops themselves. These observations did not

to repeat this operation a second, and even a third time, that the barrel may be perfectly brown: it must then be carefully rubbed and wiped, and plunged into boiling water containing a little alkaline matter, in order that all action of the acid upon the barrel may be destroyed.

When the barrel has been taken out of the water, and is perfectly dry, it must be gently rubbed with a burnishing-stick of hard wood, and heated to the temperature of boiling water: it is then ready to receive a varnish thus composed;—one quart of spirits of wine, dragon's blood in powder, three drams, and shellac bruised, one ounce. When the varnish is perfectly dry upon the barrel, it must be rubbed with the burnishing-stick, to give it a smooth appearance and lustre. I have entered into these details, because they might be extremely useful if ever the mode of bronzing musquets were adopted in France.—*Author.*

escape Marshal Saxe, who drew rules from thence for judging of the movements of military bodies, on the advance or retreat, to the right, or to the left, &c.

The British soldier has no other arms than the musquet and bayonet; the sabre is not even given to the grenadiers of the royal guard. It is a weapon which is of no use but for purposes of parade, and occasions a rage for duelling among the soldiery. If we reflect upon the frequency of sanguinary brawls, which take place in all parts of France, between the military and inhabitants, shall we not acknowledge the importance and humanity of the measure adopted in this respect in the English service? We have already remarked upon this subject, in speaking of the moral force of the British army, and we cannot notice it too frequently.

In the English service, it is only the corporal and private soldier who bear the musquet; the serjeant has, besides his sword, the pike, recommended by Marshal Saxe, Lloyd, and other great military writers.* This pike is of broad iron, and the staff near ten feet long. In charges of cavalry, the serjeants ranged in

* This opinion is, at present, generally exploded. The musquet, armed with the bayonet, is acknowledged to be the most formidable of all arms, in combats hand to hand, as well as engagements at some distance.—*Author.*

close order behind the rear rank, level their pikes, which project nearly as far as the bayonets of the front rank; in a like case, the arms of our serjeants would be perfectly useless.

General Rogniat wished that even the officers should be armed with the pike (See "Considérations sur l'Art de la Guerre"); this weapon would assuredly be more formidable than a sword, so slight and small as to be almost useless against the bayoneted musquet.

Proof of Small Arms.

As late as 1804, all the small arms requisite for the troops of Great Britain were manufactured in establishments belonging to private individuals: it was generally in London and Birmingham that this branch of industry was carried on. But the enormous wants of government, when they were busied in equipping the regular troops and volunteers, levied to repulse the projected invasion from France, decided the department of the ordnance upon forming a grand manufactory at the Tower of London.—The fabrication, repair, distribution and delivery of small arms, were placed under direction of an able officer of artillery, as inspector.*

* Colonel Miller, also director of the construction of artillery in the arsenal at Woolwich.—*Author.*

The first materials, necessary to the manufacture of these arms, are furnished to private workmen by the ordnance department, with the exception of wood, brass, nails, triggers, &c. When the different parts of the arms have been finished, they are sent to the Tower, and, if it has not been done previously, are there proved at the great depôt. At this establishment, nothing farther is done than to fit the stocks to the barrels, and mount the arms, by putting together the elements manufactured in the external workshops; indeed, during the last war, not above a third of the arms supplied were even mounted there. It is an opinion generally entertained in England, and with reason, that the government should not itself establish manufactures, except it be when branches of industry, indispensable for the public service, are not sufficiently practised by private persons to supply the sudden or regular wants of the country. The department of the ordnance has deviated from these wise principles upon the subject of the fabrication of arms. Notwithstanding the plausible accounts laid before the commissioners of military inquiry in justification of the change, we may be permitted to think, that, far from having attained real economy, the government must end by suffering greater expenses than if the supply had been confined to a free competition of private industry.

In 1808, when the English decided upon taking a powerful part in the continental war, both by their own troops, and by the people whom they endeavoured to raise *en masse* against France, one manufactory only of small arms, entirely at the charge of the state, was established at Lewisham; and its extent is not to be compared to that of several private works of the same nature in London and Birmingham.

Between the 10th of July, 1808, and the same day in 1810, Birmingham alone had fabricated 575,480 musquet barrels, and 470,018 locks.* During the same period in France, the town of St. Etienne, where our greatest workshops are situated, produced 180,000 fire-arms; while, in England, the royal establishment at Lewisham supplied but 71,266 barrels and locks in the same two years.

Shortly after the nomination of an inspector of small arms, his residence was established at

* We extract from the fifteenth report of military enquiry the following return of arms fabricated in England, and received into the magazines of the ordnance, from the 1st of April, 1803, to the 31st of December, 1809:—

Years.	*Musquets.*	*Carabines.*	*Rifles.*	*Pistols.*
1803	40,699	6,338	44	7,876
1804	167,749	4,822	325	8,181
1805	159,145	8,246	1,663	9,172
1806	143,103	11,416	3,379	9,768
1807	173,859	4,204	2,702	7,888
1808	233,744	6,838	3,997	19,585
1809	248,366	3,461	986	17,228

Author.

Birmingham, where the greater part of the barrels, locks, and metallic articles for the mounting of fire-arms were fabricated. The principal duty of the inspector at Birmingham was to superintend the proof of the objects manufactured, and particularly of the barrels of the small arms. Since the peace, an establishment for proving arms has been created at Birmingham, which merits our earnest attention; and we shall enter into some details on the subject, for which we are indebted to an interesting communication by M. Molard the younger.

The spot on which all fire-arms fabricated in Birmingham and its vicinity are proved, whether intended for the state, or for purposes of commerce, is a rectangular space enclosed by walls from four to six yards in height. To this place there is but one entrance, in front of which is an exterior court, surrounded by a grating, and containing several pieces of cannon in battery, placed there merely to indicate that it is a military establishment. The buildings connected with the site for proving arms form three of the four sides of the interior court; at one extremity of which, and detached, is a small powder magazine. One part of the range of buildings is occupied by offices: on the right, as you enter, is a foundry for balls;

and, on the left, the apartments for proving the arms.

You first cross two anti-rooms, where the arms are charged; you then pass into a small place, where they set fire to the powder by means of a red-hot iron rod; this is inserted through a small hole in the wall which encloses the room where the barrels are set for the proof. All the interior of this room is lined with plates of cast iron, from three quarters of an inch to an inch in thickness. The door and window-shutters of the apartment are also of cast iron.

The musquet barrels are set in two iron stocks; the upper surface of one of which has a small gutter, to contain the train of powder; on this train the barrels rest with their touch-holes downwards, and in rear of the breaches of the barrels is one mass of gravel, while a second is formed before the muzzles of the pieces under proof, to receive the balls.

When the train of powder is laid, and the musquet or pistol barrels placed on the stocks, the window-shutters of the room are closed, and fire is set to the train, as already mentioned, from without. From the complete mode in which every aperture in the proving room is closed up, scarcely a sound escapes when the

explosion takes place; immediately afterwards the window-shutters are opened, the smoke dissipates, and they find in the mass of gravel the barrels which have been buried in it by the force of the recoil.

The barrels are all proved with a double charge of powder and ball, and are not examined until four-and-twenty hours after the proof of firing. It is required that the saltpetre shall not appear on any point of the exterior surface; the stamp is then set upon those barrels which are good, while the bad ones are broken to pieces in a vice, by means of a machine prepared for the purpose.

The establishment, the operations of which we have just described, exists by act of Parliament of the year 1814.*

Whereas, says the preamble of this act, serious wounds are often occasioned to persons using fire-arms, by the bursting of such arms in their hands for want of having been previously proved; and whereas, a great quantity of fire-arms are fabricated in Birmingham and its environs, and it is expedient to the security of the

* "An Act to ensure the proper and careful manufacturing of fire-arms, and prevent injuries, which frequently arise from the bursting thereof, by making provisions for proving the barrels of such fire-arms."—*Author.*

public to establish in that town, or its vicinity, a proving-house under suitable inspection and superintendance; the king, by and with the consent, &c. has enacted—that no fire-arms shall be sold without previous proof, made in the proving-house either of London or Birmingham, under a penalty, the maximum of which is fixed at twenty pounds sterling,—one half to go to the poor, and the other to the informant.

The lords-lieutenants of the counties of Warwick, Stafford, and Worcester, the members of parliament for the same counties, and certain manufacturers of arms, are declared to form a political body or corporation, having alone (for those counties) the right of proving fire-arms. The administration and direction of the proving-house are confided to wardens, annually named by the majority of votes in the corporation; who also replace, in the same manner, any of the wardens dying or removing from the neighbourhood of Birmingham, during the term of their appointment.

A solemn oath, to receive neither present nor other gratification, to induce him to make the proof otherwise than fixed by regulation, is exacted of the chief of the establishment, who is termed master of proofs. Every individual marking fire-arms with a false stamp, in imitation of that of the corporation, would be guilty

of felony, and, as such, condemned to transportation for a certain term of years.

The proving-house was built by subscription, and the price paid for trying the arms is to defray the expense of erection, the salaries of the persons employed, and the interest as well as principal of the sums subscribed for the building. Differences between the corporation and individuals are to be decided,—first, by a justice of the peace; secondly, at the quarter-sessions of magistrates; or, lastly, at the assizes. All these regulations deserve to be known and studied, for they may become useful in France, whenever we leave the fabrication of fire-arms to private industry.

Supply of Small Arms to the Troops.

Before the commencement of the present century, the supply of arms to the British troops was made in a highly irregular manner, which was productive of heavy and useless expense. The commanders of corps had arms delivered to them in sufficient numbers for the full establishment of their regiments, whatever their effective strength might be; and the surplus of arms thus issued, after being kept for years in store without ever being used, were

returned to the ordnance department in a state which rendered it impossible to employ them for service, at least without the necessity of repairing them at great cost.

In 1799, however, Mr. Wyndham, then secretary at war, issued, at the request of the commander-in-chief, a regulation which put an end to these abuses. By the new arrangement, all requisitions for arms, whether made by the commanding officers of corps, or the commanders of the forces, were to be addressed to the secretary at war, in order that it might be ascertained whether the application for arms to be replaced, or added to the complement, was justified by the term of service of the old arms,* occasioned by want of care, or caused by inevitable accidents. This examination having been made, the secretary at war obtains the warrant of the sovereign for the ordnance department to issue the arms demanded. The duty of this department is not only to furnish the arms, but to pack and forward them to the regular or volunteer corps requiring such supply, on the commanding officer making known the time and place at which he wishes to receive them, whether in

* The ordinary period of service for small arms is fixed at twelve years.—*Author.*

parts or altogether. When the regiment is not in England, the agent of the corps is to apprize the ordnance office of the name of the vessel which will carry out the arms, the port where she is loading, &c.*

Articles supplied by the Department of Ordnance (according to the Regulations of the Commander-in-Chief) to regiments of—

CAVALRY.—Sabres, carabines, with bayonet and scabbard, trumpets and horns, with cords and tassels, portable forges, with anvils, bellows, &c. horse equipage, portable forges for the armourers, with chests of tools.

REGULAR INFANTRY.—Serjeants' pikes and swords, musquets (or rifles), with bayonets and scabbards, carabines for pioneers, drums and drum-sticks, bugles for light infantry, portable forges for armourers, with chests of tools.

MILITIA.—Drums and drum-sticks, bugles for light infantry, musquets, with bayonets and scabbards, belts, colors with cases, &c.

In 1817, the Parliament, wishing to render the charges for the military establishments less

* "Regulations to be observed in applying for and procuring deliveries of small arms for regiments and corps, &c. 1st May, 1799."—*Author.*

burthensome to the state, and to narrow every branch of the service to the footing of peace, took a general review of the expenditure already made, the quantities of matériel consumed during the war, and the portion that remained yet disposable. The Select Committee of Finance for 1817, in its third report to the House of Commons, gave some facts of extreme importance, of which we shall offer an analysis, upon the supply and distribution of small arms from 1803 to the close of the war.

"Your Committee," says the preamble, cannot lay before the House a more convincing picture of the efforts made in the department of ordnance during the last war, than by submitting to you a statement showing the quantity of small arms and ammunition furnished to our allies, or to our national forces, since the peace of Amiens, and the amount of arms and ammunition still remaining in store."

Arms in store at the close of the War.	*Number.*	*Cost.*
Firelocks in good order	743,000	£1,757,800
Ditto repairable	75,000	
Rifles	14,000	10,500
Carabines	36,000	64,000
Total	868,000	£1,832,300

The quantity of powder preserved in depôt in the United Kingdom was proportioned to

the number of arms, and the total value of the whole of these stores together was estimated at 3,302,300*l*. Such an immense supply appeared at first sight to exceed all amount that prudence would consider it necessary to hold in preparation. The Committee of Finance, therefore, caused the master-general of the ordnance to be required to state the reasons which justified such accumulation of a matériel, part of which was particularly destructible by time.

The department of the ordnance thus replied, in a memorial published at the end of the third report of the Committee—

"The Duke of Richmond and the late General Congreve took into consideration upon what principles it would be proper to regulate the supply of small arms and ammunition. The one thought that it should be equal to *seven* times the probable consumption of a year of war, the other to *three* times only. It was therefore determined to fix it at five times. This basis was adopted from observation of preceding wars, the course of which was so regular, as to render it possible to reduce to calculation, almost to certainty, the progress of each campaign, with a view to the condition of the powers engaged in preparation for it. But such was not the character of the last war.

By the audacious ambition and military genius of a man who held received opinions and ideas in contempt, every thing was raised to a gigantic scale; and the revolutionary spirit, which he directed, aspired at nothing less than a total change of the entire face of Europe. In such a conflict, the operations of war altogether exceeded the bounds of ordinary foresight, for instead of regular forces, whole nations armed one against the other. Dynasties, and even the names of states, disappeared before the efforts of an usurping hand, after dragging with them in the struggle the mass of the population in the countries upon which the overthrow operated. From the nature and duration of that struggle, it followed that nations were frequently seen to change their party, and sometimes even at the moment of combat, and in the thick of battle. In the midst of the uncertainty consequent upon this tendency to change, not only was the loss of magazines suffered, but, what is of more import, the means of re-organizing and completing them. That advantage might be taken of the change of disposition and policy of nations, or merely of the momentary state of affairs, so often reversed by these astonishing catastrophes, it was requisite that the nations should be enabled to rest their hopes upon some independant

and mighty power as on an inexhaustible resource. Great Britain, by her wealth, and the security of her position, became that power. It was therefore the policy, not only of the master-general of the ordnance, but of the cabinet of which he was a member, to be ever prepared with warlike stores; that no event, however unexpected, might occasion a demand for assistance that was not immediately granted, and the opportunity turned to profit by those whose duty it was to be vigilant."

"The department of the ordnance were unwilling, and would have erred, to spare any effort to give an immense extent to their means. It was a consequence of this system that, when the peace gave a sudden termination to the enormous consumption of the war, a very great quantity of supplies, ordered for the current service, and to provide against unforeseen events, necessarily accumulated at the moment in the magazines of the state."

To prove to what an extent the British government put into execution the gigantic plan of being the depôt, the manufactory, the place of arms, and the centre of the European war, it is sufficient to take a glance at the following table:

Arms furnished to the Allies, and National Troops of Great Britain, from 1803 to 1816 inclusively.

To the allies	2,143,643
To the regular troops	349,882
To the regular militia	59,405
To the local militia	151,969
To the volunteers	307,583
To the navy	215,233
Total	*3,227,715

	Fire-arms.
At the close of 1802, there were only in magazine	177,000
At the beginning of the war, declared in 1803, before the national manufactories could suffice for the demands of the service, it was necessary to procure, at any price, from foreigners	293,000
During the thirteen years, between 1803 and 1816, the manufacturers of London, Birmingham, and of the government, had fabricated	2,673,366
Total	3,143,366

Distribution of these Arms.

Worn out by use	230,000
In store	818,282
In possession of the army and navy	200,000
Total for Great Britain	1,148,282
Remaining with the allies on the continent, or lost†	1,995,084
General Total	3,143,366

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* In place of this number, the return affixed to the third report of the Finance Committee gives 3,277,766, by an error either in the total, or in some of the details composing it. I am, also, ignorant why this total does not tally with that following, the difference between them being about 100,000 fire-arms.—*Author.*

† Wherever England appears as having furnished arms or

The arms in possession of the British forces, in 1814, stood thus:

Troops of the line, including fencibles	203,440
Foreign infantry	24,328
Six regiments of Ceylon, Bourbon, and Cape of Good Hope	4,500
Regular militia	54,055
Local militia	189,383
Volunteers	15,268
Sailors and royal marines, about	60,000
Troops of the ordnance, about	4,000
General Total	554,974

Of these arms, about 200,974 remained in the hands of the army and navy in 1817. There had, consequently, been re-

turned into the magazines	354,000
And there were in store when the war terminated .	384,282
Musquets of the new model, fabricated since the peace . .	80,000
Total provision in 1817	818,282

It appeared, then, that there had been really but 384,282 fire-arms of the old model accumulated by the department of ordnance, beyond those which had actually belonged to troops on foot during the war.

General Evain, director of the division of artillery and engineer services in the French mi-

ammunition to the allies, says the ordnance department, it is not to be supposed that they were supplied gratuitously. It only signifies that *we were the market* at which our allies purchased their stores and arms. It is to be observed, also, that all the arms borne upon the preceding returns, were not furnished new; a certain number were returned after use, repaired again, and then sent out afresh.—*Author.*

nistry of war, has been kind enough to furnish us with the following table of the fabrication of small arms for the French troops, which it may be interesting to compare with those we have just given.

General Return of the Fire-arms, Fabricated in the Manufactories of the French Government, from the 1st of Vendemiaire, year 11, to the 31st of December, 1814.

Places.	Musquets.	Carabines.	Rifles.	Pistols (pairs.)	Total.
Roanne .	13,519	,,	,,	,,	13,519
Calembourg	6,743	24	,,	,,	6,767
Liege .	271,931	7,109	,,	,,	279,040
Versailles	93,271	5,138	2,212	1,173½	101,794½
Turin .	101,985	4,597	,,	703	107,285
St. Etienne	631,954	41,137	,,	81,536½	754,627½
Tulle	79,597	22,971	,,	4,422	106,990
Maubeuge	195,423	47,990	,,	53,286½	296,699½
Charleville	399,027	86,367	,,	61,709	547,103
Mutzig .	232,850	9,275	,,	307	242,432
TOTAL	2,026,300	224,608	2,212	203,137½	2,456,257½

Recapitulation of the Fabrication of Arms (by Years.)

Years.	Musquets.	Carabines.	Rifles.	Pistols.	TOTAL.
11	89,461	13,226	,,	12,005	114,692
12	130,429	7,638	,,	10,705	148,772
13	135,940	11,134	,,	14,323	161,403
14*	46,509	4,712	,,	5,821	57,042
1806	147,171	13,349	631	7,459½	168,610½
1807	167,287	3,804	381	21,262½	192,734½
1808	174,197	8,654	,,	12,666	201,517
1809	195,987	6,401	,,	21,369	223,757
1810	230,894	8,168	,,	20,732½	259,794½
1811	209,462	14,533	603	19,395	243,993
1812	127,158	74,602†	597	17,232	219,589
1813	209,536	47,310	,,	29,038	285,884
1814	162,263	11,077	,,	5,129	178,469
TOTAL	2,026,300	224,608	2,212	203,137½	2,456,257½

* This year, the last of those computed according to the republican era, only embraced three months and eight days.—*Author.*

† This great and sudden increase in the fabrication of carabines was occasioned by the augmentation which Napoleon made at that epoch in the effective of his cavalry.—*Author.*

To this general total of	2,456,257½
Add, first, musquets fabricated prior to 1803, and repaired in our work-shops . .	800,000
Secondly, musquets taken from the enemy between 1803 and 1814	700,000
We procure this general total of arms, rendered disposable for the service of the French army, from 1803 to 1814	3,956,257½
The British were only able to purchase and fabricate in the same period	3,143,366
Difference on the side of France	812,991½

We shall close this part of our subject, with some very remarkable facts, connected with the progressive extension of the manufacture of small arms in England.

The magazines of the ordnance were in such a state of exhaustion, at the close of the first war against the French republic, that the ministry were, for some time, in consternation and uncertainty, whether they should have the power of arming all the men who were summoned to the defence of the kingdom from invasion. It was on this account that a portion of the militia and volunteers were, in the first instance, armed with pikes.* At the epoch at which we speak, the department of the ordnance had scarcely 150,000 firelocks for the regular army, which amounted to 177,000 men.

* Memoir upon the accumulation of stores at the conclusion of the war in 1815, p. 99.—*Author.*

The government were, therefore, obliged to conclude bargains in all haste, at a disadvantageous rate, with a greater part of the nations of Europe, for near 500,000 firelocks, which cost about £700,000.*

The provision of arms was yet more scanty in 1793 than in 1803.† It was necessary at the former period, as well as in 1802, to have recourse to foreign nations for the supply of the greater part of the matériel of ordnance, and particularly small arms. Will it be believed, that at the moment of the declaration of war, there were not 47,000 musquets in the Tower of London, nor above 13,000 in the armouries of all the out-ports?

On the 1st of June, 1814, owing to the immense progress of the British manufacturers, there were in the magazines of England 480,380 firelocks, notwithstanding that the ordnance

* It will be observed, however, that in the returns given by the author (some pages back) and copied from the reports of the Military Inquiry, the number of fire-arms actually purchased from foreigners, at the opening of the war of 1803, is stated at 293,000 only, instead of 500,000.—*Tr.*

† It may be seen, from the Aide Mémoire of General Gassendi, p. 640. that France had, in 1771, a provision of 558,000 musquets; in 1789 this amount had been increased to 700,000; in 1811 we had, without including the arms of French troops and foreigners in our pay, a reserve of from 5 to 600,000 musquets.—*Author.*

department had issued, whether to the national troops or allies, 264,000 since the 1st of January of that year. In 1813 alone, more than 500,000 musquets were demanded from the ordnance, and the requisition was met by that office.* When the fresh war of 1815 broke out, the ordnance department set no bounds to the extension of its means. To quote the words of the official memoir, from whence the fact has been drawn, "it was the principle of that campaign, by an overwhelming force, united at once from all parts of Europe, furnished with all the means which it was physically possible to acquire, unrestrained by ordinary rules, to crush the usurper at one blow." The master-general, proceeding upon this principle, and acting in concert with the cabinet, of which he formed part, gave orders to the board of ordnance, to spare neither time, nor expense, nor exertion, to attain the most important of all objects, a provision of arms, which could not be exhausted. In consequence of these instructions, and to encourage workmen, the board of ordnance promised

* To show how necessary it had become to have a superabundant supply of arms in readiness, the English relate, that they lost, at one blow, 60,000 musquets, which had been sent to Dantzic; and 100,000 arms were lost in a single shipwreck. —*Author.*

to take, during a certain period, all the musquets which it would be possible to furnish.

The ordnance then received a thousand musquets a day; and yet, adds the memoir, notwithstanding all that we had in store, *if the battle of Waterloo had not been decisive, we probably should not have been in condition to satisfy demands for arms with sufficient promptitude.*

CHAPTER III.

Of the Provision, Consumption, and Fabrication, of Gunpowder—Of Congreve Rockets.

It was essential that the store of powder, collected by the British government, during the last wars, should be proportioned to the quantity of arms provided for the service. Thus we find that, in 1817, at the epoch when the department of ordnance reckoned more than 800,000 firelocks in their depôts, the magazines of Great Britain contained above 294,000 barrels of powder.*

* The barrel of powder contains one hundred pounds; but for some time, says Adye, in his "Manual for the Gunner and Bombardier," one-tenth less than the full quantity has been packed in each barrel, so as to leave an empty space, by means of which the powder has room to shift about when the barrel is in motion; this preserves it better.—*Author.*

But, of this supply, 117,000 barrels were kept in floating magazines, which were so little calculated for the purpose, that the powder could never be removed from them for use, without being previously aired and rolled.*

Until 1812, the average consumption of powder during the last war was about 80,000 barrels a year; but in 1813 and 1814, it was much more considerable. The war in Germany (says the department of ordnance in its memoir already quoted) had assumed a gigantic aspect; whole nations prepared to rise *en masse*, and wanted but the means of arming themselves. This circumstance will not excite surprise, if we reflect that Buonaparte was master of all the resources which the manufactories of Holland and of a great part of Germany could furnish, that he had twice exhausted the magazines and arsenals of Austria, and once those of Prussia. The armed population of Russia has always been beyond proportion to her means of providing them with weapons. The new allies reckoned upon England to supply their wants, and the event proved that their reliance was well placed.

To justify the extent of their provision of

* With the best apparatus the British only air and roll about 40 barrels of powder per diem, and, with less perfect means, not above 14.—*Author.*

powder, the ordnance department observe that, in 1813 and 1814, the allies, in invading France, had reason to expect that they should be under the necessity of making a war of sieges; when Buonaparte was driven back upon the Rhine in 1814, his first policy was to oblige the allies to waste themselves in sieges. *I shall amuse them among my fortresses*—wrote he to his empress. He abandoned this system, and caused his ruin. If he had kept his intention, no one could have foreseen the extent of the provision of powder which it might have been necessary to make. The same reasoning applies to the campaign of 1815.

The British ministry observed, with equal force and reason, that it was indispensable to have vast resources to enter into the first ranks of a coalition which might, in 1815, have ranged under arms more than a million of men, and had actually encamped at one time on the French territories from seven to eight hundred thousand. In 1815, the Duke of Wellington had 42,000 barrels of powder accumulated in the depôt at Ostend; and, independent of an immense train of artillery, Great Britain supplied to the king of the Netherlands 22,000 barrels of powder. It is interesting to be acquainted with all these facts, which are materials for the history of so memorable a campaign.

Usually, at the close of the wars before the last, the department of the ordnance, after reserving a quantity of good powder, sufficient for the wants of a peace establishment, instead of selling the superabundant quantity, preferred to decompose it, and extract the saltpetre for sale as an article of commerce. But upon occasion of the last transition to peace, the ordnance being necessitated to attend to the injunctions of Parliament, to reduce their superfluous matériel as low as possible, concluded an extensive bargain with a single individual, who agreed to take all the powder and stores of which they might wish to dispose.

Qualities and Fabrication of Powder.

We are yet possessed of no well-drawn comparison between the qualities of the English and French powder. It has merely been perceived, by many isolated facts, that, generally speaking, the gunpowder of the English had, during the last wars, more strength than that of the French; but, within a few years, the two MM. Champy, father and son, have brought our powder to great perfection. M. Lefevre, chef-de-bataillon of artillery, and formerly a pupil of the polytechnic school, has re-established the manufactories of Essone, with im-

provements which promise valuable results; and lastly, as one of our most celebrated chemists, M. Gay Lussac, is attached to the direction of our powder and saltpetre, we have reason to hope for a series of comparative experiments on this subject, which may turn to the advantage of an important art.

We only use one kind of powder for all our fire-arms, while the English employ two sorts; their coarse powder is intended for throwing heavy projectiles, their fine powder is reserved for small arms. The government have two manufactories for powder; one at Feversham, the other at the old Abbey of Waltham. But during the war the greater part of their powder was furnished by private manufacturers.*

* To prove the powder, in the manufactories of government, it is rubbed between the fingers, to ascertain that it contains no hard particles. There are then burnt, upon a copper plate, about two drachms avoirdupoise of the powder to be proved, and the same quantity of the best already proved. It is required that the mixture shall emit no sparks, and leave no remains of deposit upon the copper. The next trial is to charge a mortar, of the calibre of eight inches, with two ounces of powder, and a ball for proof, weighing sixty-four pounds. The best powder in this case gives a range of sixty yards, the projectile being elevated to about fifty. The weakest powder, such as that which has been dried, carries only from about thirty-five to forty yards.

Of the powder purchased from individuals, the government

For several years the process employed in the fabrication of gunpowder has been carried to a great degree of perfection in England, yet it still appears to be in most respects inferior to the system pursued at present in France, and which unites all the science of chemical

require that it shall give a range, not less by above one-twentieth than that of their own manufacture; the comparative trials are made on the same day, at the same time, and under circumstances exactly similar. To prove the fine grained powder, reserved for small arms, a musquet barrel is charged with four drachms of powder, and an iron ball, which must pierce through a certain number of wet elm boards, each half an inch in thickness; these boards are placed three quarters of an inch asunder, the nearest being forty feet from the musquet barrel. With government powder the ball will penetrate through fifteen or sixteen of these planks; with aired powder not above from nine to twelve. The last proof of powder consists in exposing to the air, during about seventeen or eighteen days, 5 oz. 6 dr. of each sort carefully weighed; during this time, says Adye, if the powder is pure, its weight will not be sensibly encreased by taking up moisture from the atmosphere. This appears to us to be perfectly erroneous, for good powder is far from having no capacity for absorbing the water held in evaporation in the air. It may thus easily be conceived that eighteen days of dryness would diminish, instead of encrease, the weight of the powder, while a single day of extreme moisture would saturate it with water. This is therefore a very bad mode of experiment. However, the English admit that, in the proof which we have been describing, good powder should not absorb more than three-fourths of a unity for one hundred of its weight.—*Author.*

theory with the simplicity of the most efficacious mechanical means.

The English prepare the charcoal which they use for their powder, by purging the wood of the volatile substances contained in it, in the same manner as they purify coal to reduce it to coke. The wood to be carbonized is placed in iron cylinders, to which pipes are adjusted for the escape of the vaporized water, as well as other gases and pyrolignous acid, which are liberated from the wood. The pyrolignous acid is afterwards condensed, and applied to very important and numerous purposes. It appears that part of the good quality of the English powder is owing to this method of preparing the charcoal. The application of the hydraulic press, to give to the mixture of saltpetre, sulphur, and charcoal, a compactness which is one of the essential elements of the strength of powder, should also be quoted as an improvement in the process. We shall describe this application in speaking of the hydraulic presses and their different uses (Book XI.)

The English powder is composed of seventy-five parts of saltpetre, fifteen of sulphur, and ten of charcoal. The two Generals Congreve, father and son, have bestowed much attention upon the means of improving the manufacture of powder; and the latter is inventor of a pro-

cess for which he has taken out a patent. We shall not here enter into an enumeration of the advantages of this process, which have been exaggerated by the author according to his habitual method. He employs an ingenious but complicated machine to mix the saltpetre, sulphur, and carbon, of which powder is composed, in a perfectly equal manner in their respective proportions.

A trough or funnel, for each of the three primary constituents, is disposed in such a manner, that the three funnels are fixed in a straight line, at the same height, and in one frame; a cylindrical brush of horse hair, or other suitable materials, about three inches in diameter, and from six to eight inches long, is made to revolve on an axis, placed in an oblong aperture at the bottom of each trough. The elementary material rests upon this brush in the trough, and when the brush turns, the material runs down like a fine ribbon, of the same breadth as the length of the brush, in the manner that webs of cotton are drawn out by the revolution of carding cylinders.

According as the cylinder is distant from, or nearer to the bottom of the trough, the stream of the material passing down is more or less considerable. Otherwise, when the cylinders remain at the same distance from the bottom

of their funnels, it is evident that, in varying the swiftness of the revolution of the cylinders, the quantity of material which passes down will be in the proportion of their respective velocities. It is therefore easy to combine and regulate the motion of the cylinders in such manner, that the quantity of saltpetre, sulphur, and charcoal coming through the funnels at the same time, shall be in the precise proportions which suit for the fabrication of the powder.

Under the funnels, and held by the same frame, a narrow endless band, made either of leather, cloth, or other material, is fixed upon rollers, so as to receive a continued horizontal motion, by the same power as that which turns the cylinders. The three streams of the constituents of powder, thrown down by the cylindrical brushes, fall upon this band, and are carried by its motion with a much greater velocity than that with which they passed through the funnels; the streams are consequently spread over a greater extent, and their thickness proportionately lessened. The strata thus formed on the band are, as they approach the most distant roller which bears the endless band, thrown from the latter, and fall into a common reservoir.

But, to render yet more complete the mixture of the constituents of the powder, and to

divide such masses as have escaped the preceding method, a second machine is employed analogous to that which we have just described. It has only one funnel with a large cylindrical brush, the part of which, turning inside the funnel, rubs against a metallic sieve of very fine web, and which embraces one half of the circumference of the brush. In this way, the brush has the effect of a press, so that the particles of powder too large to pass at once through the sieve yield to the pressure of the brush, are broken, and then fall through without difficulty.

General Congreve reduces the mixture of the constituent materials of powder into very small and very compact grains, by the pressure of *fluted* cylinders, instead of using them *smooth*. A second pair of smaller fluted cylinders,* and a third pair of the same, upon yet more diminished a scale, serve to granulate the powder. After undergoing the action of the first pair, the powder falls upon a sieve, which retains only

* The teeth or fluting of the cylinders may be shaped upon several different plans; sometimes they are cut parallel to the axis of the cylinder in right lines, sometimes spirally, as in those employed in bruising sugar canes; and occasionally in circular rings, the planes of which are perpendicular to the axis of the cylinder. These rings have intervals between them equal to their breadth, so that the ring of one cylinder fits into the interval between two in the other.—*Author.*

such larger particles of it as are intended for use with cannon; the rest runs through and falls upon a second sieve, which retains the fine powder for small arms; and lastly, the impalpable powder goes through the second sieve, and runs into a separate reservoir.

This machine can granulate more than six barrels of powder per hour, and seems to offer a greater economy than that usually employed by the British. By the ordinary means (General Congreve assures us) the quantity of dust, or impalpable powder, is equal in weight to the whole of that fit for use; while, by his new method, the dust *does not form one-twentieth part of the whole.* The grain is more uniform and more solid, its surface is harder, more regular, and smoother, and falls less easily into dust from the effect of the atmosphere.

To preserve the powder thus fabricated, General Congreve would enclose it in wooden barrels, lined with a plating of copper, lead, or tin, so as to intercept all hygrometrical communication between the exterior and inside of the barrel, and preclude air as well as water from acting upon the powder. One of the ends of the barrels has an opening, small enough to be luted with wax and tallow, or with a mixture of tallow and resin; the whole being protected by a false head to the barrel, to obviate the effects

of blows or friction. In order to make the same quantity of powder occupy a lesser space, which is often of great consequence, (on shipboard, for instance,) General Congreve substitutes for barrels rectangular wooden boxes, lined with metallic sheeting after the same system.

Congreve Rockets.

The people of Hindostan were the first who employed as destructive projectiles the rockets termed *Congreve*, and presented by that General as the fruits of his genius. The Indians formed their rockets of a case of iron attached to a bamboo cane. Tippo Saheb used them with effect against the English at the siege of Seringapatam, in 1799. It was only in 1805 that Congreve, then a lieutenant-colonel, made, in presence of the principal ministers, trial of his inflammatory rockets. This experiment was afterwards repeated on the great scale in the bombardment of Boulogne, Copenhagen, Flushing, &c.

Up to that time the rockets were only used on board of vessels, but they have since been adopted for the land service. Towards the close of the late war, a rocket corps was organized upon the same establishment as a squa-

dron of horse-artillery, and a portion of this body was attached to the allied army, with which it served, particularly at Leipsic. From this circumstance the colors of the troop bear the word "Leipsic," in commemoration of the victory.

The following (according to Falconer) is the construction of the rocket with the last improvements. The envelope or case, of the thirty-two pounds (avoirdupoise), is four feet and a half long; the diameter of the iron head, or cap, is six inches and a half, and that of the case at the smaller end four inches and a half. The shell is filled with a composition of an extremely hard and compact nature. The shaft or tail is eighteen feet long, and is so disposed that it is held firmly, and prepared instantly for action by passing it through two sockets, and screwing the end into a ring which fastens it immoveably into the rocket.

The expense of the Congreve rockets has been very much exaggerated, says an apologetical paper, apparently drawn up by the author himself; but the fact is, that they are the most economical of projectiles used with powder. Thus, the rocket of thirty-two pounds complete, and in every way ready for action, costs only £1 : 11*s.* 6*d.* while its equivalent, the spherical carcass of ten inches, with the charge of pow-

der necessary to give it a range of 3,300 yards (that of the rocket) costs £1 : 2*s.* 7*d.* independent of the expense of the mortar, its bed, platform, &c. and the difference of the cost of transport, which the bomb service entails; while the use of the rocket requires neither apparatus for employing it in bombardment, nor any charge of powder for propelling it. A vessel of three hundred tons can carry 5,000 rockets at least, and altogether, it has been ascertained by calculation, that there is a saving of three pounds sterling upon every shot, by using the rocket instead of the 10-inch shell.

Employment of Rockets in bombardment.

First. *By means of a talus without apparatus.*—Congreve determines that a talus some yards in length is sufficient to fire rockets in considerable numbers, because they can be ranged in grooves or notches in the slope previously prepared to receive a certain proportion of them, and be thus disposed for a volley, along the length of the bank. The rockets are, in this case, placed at eighteen inches distance one from the other, kept steady by pegs planted on the slope of the bank, and the shafts of the rockets inserted into holes made to receive them at the foot of the talus; the rockets can

either communicate together by conductors, or be fired separately.

This simple contrivance gives great facility for firing the rockets in large vollies. To obtain the greatest range, it is recommended to shape the slope so as to form at least an angle of fifty-five degrees; in places where there are natural slopes, or on the talus of fortifications, this mode is the simplest that can be adopted.

Secondly: *By means of a portable frame.*—If a rapid operation is meditated on a point where there is no prepared talus to be found, or where trenches cannot be opened, the frame must be used. This apparatus resembles the easel of a painter, or a gardener's ladder. Separated from its fore legs, it can be used on board the smallest vessel, the inclination of the plane being effected by the fore halyards and mast of the vessel. With its legs, it is excellent for firing, is pointed by means of a lead-line, and has at the upper part a small bucket of water to spunge after every discharge. A common artillery waggon can carry two frames with about a hundred thirty-two pound rockets. In less than five minutes these frames can be fixed, and ready for service; their direction, their elevation can be very easily changed. They are made to hold two rockets at once, and four

persons are sufficient to serve each frame. The rockets are fixed by a man who ascends the steps of the frame; in five minutes, four rockets can be shot off from each frame, without haste or confusion.

The working of the frame for bombardment is carried on as follows: the *first man* serving the frame, mounts the steps to spunge the iron chambers from whence the rockets are shot off, which he must do after every discharge, with a very wet spunge. Then, having primed the two chambers with a small hollow tube of powder, he places one rocket in each, and charges the two locks after every thing besides is prepared, taking care to place the string for pulling the triggers of the locks in a proper situation. The *second man* receives the rocket from the third, and passes it to the first, after having carefully stripped the touch-hole of the cloth which covered it. This man also assists the first in whatever he requires, and pulls the trigger when he gives the word. This the first man does as soon as he has retired fifteen or twenty feet in rear, to avoid inconvenience from the smoke. The *third man* has only to carry the rockets to the foot of the frame, where he delivers them to the second. He may carry them one by one, or two at a time, but is never to carry a fresh one until the others are dis-

charged. The *fourth man* is placed with the rockets and their shafts at a sufficient distance in rear, where he opens the boxes in which the rockets are packed by sixes. As this is only the work of a moment, he does not touch one box until he has served out all the rockets of another to the third man.

This distribution renders the work of each extremely simple, and it is thence evident that, with forty men and ten frames, a very powerful fire may be maintained. A non-commissioned officer may easily superintend two or even three frames, and one officer can command the whole.

Whatever be the number of frames, they should not be nearer to each other than from ten to twenty yards, in order that the charging, firing, &c. of each rocket may proceed independently, and without interruption or embarrassment.*

Use of Rockets in the Field.

There are two species of rockets applicable to service against troops in the field. The first is the howitzer rocket of thirty-two pounds,

* An attempt was, we believe, made at the bombardment of Flushing, to fire rockets from cannon, but it was not found to answer. It is needless to say that this was done without shafts.—*Tr.*

which carries a Shrapnell shell of nine pounds to the distance of 3,300 yards, a range at least double that obtained with any other species of artillery. The second is a species of small rocket equal to a six-pounder case-shot charge, carrying 2,200 yards, and which infantry might use with the hand.

The howitzer rockets of thirty-two pounds must be fired with a field-gun carriage, which transports fifty-four charges in its ammunition-box. Being nothing more than a light gun-carriage upon wheels, without the cannon, it must be beyond doubt, lighter than any field artillery, while the projectiles for which it is used have a much greater range than those from the heaviest guns employed in the field. The same number of men as are requisite in a bombardment to manœuvre rockets discharged from frames, is more than sufficient to work those fired from a field carriage.

The portable case-shot rocket already mentioned, is intended to be worked with a light frame which a man can carry. The rockets themselves can, in like manner, be carried manually, three or four per individual. A company of infantry can thus, therefore, without the least embarrassment of a train of horses, possess the projectile force of two or three hundred charges of six-pounder case-shot with a

range of 2,200 yards, which is nearly double that of common field-artillery.

Independent of the direct fire, it is thought that the rockets will give an extensive ricochet, without using either frame or gun-carriage, by simply placing them on the ground, or, at most, affording them a support with two little pickets planted in the earth, and crossed at top to receive the ends of the rockets, and occasion them a trifling elevation.

General Directions for firing Rockets, with reference to the state of the Wind.

A moderate breeze does not at all affect the course of large rockets; but if a fresh gale blows across the direction in which they are shot, they must be pointed to windward of their object. If the wind blows in a direction against the course of the rocket, it must have a slight increase of elevation; for instance, to procure the maximum of range, the angle must be of 60° instead of 55° as already mentioned. But if the wind, on the contrary, blows in the same course with the rocket, the pointing must be lowered in elevation; thus, to procure the greatest range, the angle of 50° is to be chosen in lieu of 55°. It is indeed, readily to be conceived that, in the first of all these cases, the

rocket must have a tendency to run to leeward, to fall off from the wind that blows across its course. It must therefore be pointed to windward, with an inclination equal to that of its falling to leeward. In the second case, the resistance of the air is encreased, and the rocket will not carry so far; in the third instance the effect becomes the reverse. The rocket is therefore to be pointed higher or lower accordingly.

It is requisite to pay attention in screwing the shaft as much parallel as possible to the axis of the rocket; and, in cases where the correctness of the direction is essential, to use no shaft that has warped. The rockets must be placed with great precision on the frame, the shafts fixed straight behind them, and the chambers in which the rockets rest fastened in parallel to the sides of the frame, that the shafts may not be bent.

List of the different kinds of Rockets manufactured by Colonel Congreve.

Nature of the Rocket.	*Loaded with*	*Extreme range.*	*Elevation to procure the extreme range.*
		yds.	
Carcass of 32-pr.	Large, 18 lbs. of combustible matter.		
	Small, 12 lbs. ditto. - -	3,500	- - 60°
Howitzer shell ditto	5½ inches - - - - -		
	12 lbs. spherical - - -		
Carcass of 32-p.	Large, 18 lbs. of combustible matter - - - - - - -	2,000	- - 60°
	Medium, 12 lbs. ditto=to a 5-inch shell - - - -	2,400	- 60° to 55°
	Small, 18 lbs.=10-inch shell -	3,000	- - 55°

Howitzer shell of 32-p, 9 lbs. spherical		3,000	50°
Case-shot ditto	Large, containing 200 carabine balls	2,500	55°
	Small, ditto 100 ditto	3,000	50°
Case-shot, 12-p.	Strong iron cones, containing from 5 to 12 lbs. of powder to be exploded by the rocket	from 2,500 to 3,000	55°
Ditto, ditto	Large, 72 carabine balls	2,000	45°
	Small, 48 ditto	3,000	45°

Balloon Rockets, or Fire Balls.

Congreve, by means of his rockets, throws a light ball, which, after having attained the highest point of its range, separates from the rocket, and remains suspended in the air by a small parachute, to which it is fixed by a chain. In this manner, in place of the momentary glimmer caused by the common fire ball, a vivid light is obtained which remains suspended in the air for at least five minutes, a sufficient time to observe the motions of an enemy at night, whether at sea or on shore. On shipboard, this method would be particularly useful in directing a chase or communicating signals at a great distance. It should be observed, also, that no effect of the sort can possibly be procured by the projectile force of cannon or mortars, because the explosion would infallibly destroy the apparatus intended to produce the suspension in the air of the luminous body.

The great inconvenience of the shaft, or directing tail of the rocket, disposed as we have already described, is that its axis is not in the

same direction with that of the rocket. It hence follows that in the progressive course of the rocket, a movement of irregular rotation is produced, which the velocity of the projectile renders greater in proportion as it is itself accelerated. To remedy this heavy inconvenience, the two axes are made to coincide. The throwing of rockets, too, is now no longer confined to directing them, like shells, at a great angle of elevation; and they carry balls and howitzer shells in a horizontal course.

By making experiments of all kinds during a period of almost fifteen years, it appears that great precision has been attained in the firing of rockets. In the summer of 1819, comparative experiments were made between rockets and pieces of cannon in the throwing of balls at a medium range; and there were more rockets than guns whose balls entered the targets.

It would, therefore, probably be attended with great utility to revert in France to the examination of this means of destruction; and there can be no doubt that, were it entered into seriously and earnestly, we might reach some degree of perfection in the use of rockets, since the British have done so. One of the most important points in the fabrication of rockets is the proportion of substances composing the fire-work: this proportion varies according to

the force of the rocket, as may be seen by the following table, which is taken (we are informed) from the most recent and best manufacture.

Composition of Rockets for throwing Balls.

Calibres.	1 to $2\frac{1}{2}$	3	6	12	18 to 24	32	42
Oxymuriate or Chlorate of Potash	4	5	6	$7\frac{1}{2}$	9	10	12
Saltpetre	2	$2\frac{1}{2}$	3	$3\frac{3}{4}$	$4\frac{1}{2}$	5	6
Sulphur	1	1	1	1	1	1	1
Charcoal	1	1	1	1	1	1	1
Length in Inches . .	7	8	9	$10\frac{1}{2}$	12 to $13\frac{1}{4}$	16	18
Diameter do.	$1\frac{1}{2}=1.9$; $2\frac{3}{4}=2.2$	$2\frac{3}{4}$	$3\frac{1}{2}$	$4\frac{1}{2}$	5 to $5\frac{3}{4}$	6	$6\frac{1}{2}$

Composition of Rockets to throw Carcasses.

Diameters.	*6 inch.*	*7 inch.*	*8 inch.*
Oxymuriate or Chlorate of Potash	14	16	8
Saltpetre	7	8	20
Sulphur	1	1	1
Charcoal	1	1	1
Length in Inches	20	22	$24\frac{3}{4}$
Diameter do.	6	7	8

The length indicated in the preceding tables is the total length; the diameter is taken on the exterior circle, measured from the rockets which were in preparation in 1819 to be sent out to Ceylon.*

* There must be some error in the proportions of the chlorate of potash; such great quantities of so dangerous a material would render the preparation and use of the rocket too dangerous; the composition, which we have here cited, differs essentially from the proportion of matter detected by D'Arcet, in the analysis which he made of the Congreve rocket.—The memoir of M. D'Arcet is inserted in the bulletin of the society "d'Encouragement, No. CXX. Paris, 1814."—*Author.*

BOOK X.

OF ORDNANCE.

CHAPTER I.

FIELD ARTILLERY.

WHEN the English troops, in the year 1815, encamped in the Champs Elysées and under the walls of Paris, one of our most skilful artillery officers, the chef-de-bataillon Parizot, endeavoured to acquire a thorough knowledge of the field-artillery that accompanied the British army on that occasion. He examined it attentively, at frequent intervals, and was fortunate enough, notwithstanding every difficulty, to gain the most essential information; these results have enabled him to compose a very interesting memoir on the subject, which, from the author's friendship, we have it in our power to lay before our readers, and we feel the more inclination to do so, as it is a production likely to give the highest idea of the solid judgment and quick perception of such an observer.

Arrangement of the Subject.

The new system of field-artillery adopted by the English appears to have the following advantages over that of the French:—First, a very great simplicity in the mode of equipment; secondly, a great facility of limbering and unlimbering; thirdly, their wheels run more easily than ours; fourthly, all the artillery-carriages are capable of conveying men; fifthly, there is every facility for the storage of ammunition; and, sixthly, an excellent system of draught, calculated to admit of either one or two horses being driven a-breast: we may add, that this system of draught is the complete solution of the problem proposed in the Aide-mémoire of General Gassendi (*pages* 838 *and* 1199, *quarto edition.)*

First; *Of the simplicity in the mode of equipment.*—The English employ one common wheel of the same dimensions, for all their field-artillery, and likewise but one description of limber; thus the same wheel and the same limber will suit a nine-pounder, and $5\frac{1}{2}$-inch howitzer carriage, the ammunition-car, the forge-cart or waggon, and the wheel-car. (We have never observed the English field-12-pounder among the guns parked at the Champs Elysées, and the

Bois de Boulogne.)* They use but one description of traversing handspike, and have abolished the use of tree and trace-bars; the wear and tear of these articles being considerable, and the supply costly and embarrassing. An ammunition-box, remaining permanently on the limber, answers the purpose of the one which we place between the carriage cheeks.

By the following table, the simplicity of the *matériel* of the English artillery will be evident, when compared with the French artillery, even since the late improvements introduced into this branch of our service.

	French Artillery.	*English Artillery.*
3 Limbers.	Limber of the new pattern common to the 6-pr. 12-pr. & howitzer Limber of the ammunition-car . Waggon and forge-cart limber .	Only one kind of limber in use.
3 Wheels.	Wheel of the new model, common to the 6 pr. 12-pr. and howitzer Large wheel of the ammunition-car, forge-cart and waggon . Small wheel of the limber of the 6-pr. 12-pr. ammunition-car &c	Only one description of wheel in use.
Axletrees.	Axletree No. 2 . . . . . . Axletree No. 3	Likewise but one kind of axletree.
	Shafts for mountain service .	Abolished.
4 Trace-bars (*volées*)	Rear trace-bar for the gun-car. . Rear do. for the amm.-car, &c. . Front do. for the gun-carriage . Front do. for the amm.-car, &c.	Abolished.
	Coignes	Abolished.
	Two traversing handspikes . .	Only one sort employed.

* The English 12-pounder (whenever used in the field, which very seldom occurs) has a wheel different from that employed in common for the 6 and 9-pounder, and the $5\frac{1}{2}$-inch howitzer.—*Tr.*

The English, consequently, from having simplified the *matériel* of their field-artillery, need only take into the field one kind of felloe, spoke, axletree, &c. for the supply of any emergency.

Secondly; *A great facility of limbering and unlimbering.*—The introduction of the pintrail* *(cheville ouvrière)* behind the body of the axletree of the limber, and of the pintrail eye *(anneau-entretoise de lunette)* at the end of the trail of the gun-carriage, very much facilitates the limbering and unlimbering. In the French artillery, the *chaine d'embrelage*† is not within the reach of the gunners, because either the horses or the splinter bar must interfere, whilst, in the English artillery, every thing is at hand. The trail staples, *(des poignées en fer)*

* The new pintrail of the English service is very different from the old, which probably was much the same as the French *cheville ouvrière;* but as the new and old pintrails, though of different construction, were both intended for the support of the trail, the French *cheville ouvrière* may still be allowed to correspond to the term pin-trail. See the author's observations on these improvements commencing page 209.—*Tr.*

† *La chaine d'embrelage* corresponds, perhaps, to the chain formerly used in the English artillery, to prevent the trail from slipping off when the gun was in motion; since the improved construction of the pin-trail, this chain has been replaced by a ring and key which keep the trail, when limbered up, firmly in its position.—*Tr.*

placed on the right and left of the trail of the gun-carriage, enable the gunners to unlimber with rapidity and ease, because they have a good purchase, and act at the extremity of a long lever. But it is in the act of limbering up that the superiority of the English artillery is most evident. With us the splinter-bar* *(la sassoire)* obliges the gunners to make greater efforts, because they must raise the trail of the gun-carriage nearer the axletree; and the gunners are likewise necessitated, on account of the height of the pintrail of the French artillery, to hold the trail of the gun-carriage in a position, in which the muscular force of the man is not employed to the greatest advantage, and in addition to this, the insertion of the pintrail into the pintrail eye *(l'entretoise de lunette)* must be done almost at random. In the English artillery the gunners are not in the least incommoded, can see every thing, and have no occasion to lift the trail of the gun-carriage higher than where the muscles are capable

* There is but one splinter-bar in the English limber, and this, of course, in front and not in rear of the axletree. The one alluded to here is evidently in rear of the axletree, and must, therefore, very much incommode the gunners whilst lifting the trail upon the pintrail of the limber. The reader may, perhaps, object to the word splinter-bar, as used above, but he will, at least, understand by the term, a bar of wood of similar construction to the splinter-bar, though differently placed.—*Tr.*

of the greatest exertion; and the fitting the pin-trail eye on the pintrail (the *cheville ouvrière* of the limber) is not attended with any difficulty; the ring and key for securing the trail upon the pin are, besides, directly at hand. When we speak of the British system of draught, we shall notice the solution of the problem concerning the ammunition-box, permanently attached to the limber; a problem completely solved by the present improved state of the English artillery. The arrangement, by which the ammunition-box is affixed to the limber, is best calculated to avoid the loss of valuable time in preparing for action. The English field-piece can, with the same facility, be manœuvred at the *prolonge* when joined to its limber, as by manual exertion, and the manner of attaching it is very simple by means of the pintrail of the limber, and the eye *(piton)* of the trail of the gun-carriage. But the ease with which this artillery can prepare for action, and again limber up, diminishes very much the importance of manœuvring *à la prolonge*.

Thirdly; *The wheels possess more ease of motion than ours.*—I have often been told, even by officers of the arsenals, that low front wheels give full play to a carriage, and facilitate its movement. It is evident, on the contrary, that low front wheels impede a carriage, and that, if

they are useful, it is only in case of descent; but, as there are ways enough of restraining a carriage in its onward motion, we ought always to employ the highest possible wheels. And it is generally said that, in every case, the traces should be as high as the horse's breast, with a sufficient upward tendency, to admit of the draught being from below rather than from above the level of the horse's chest.

The wheel used in the English field-artillery is five feet in height, and consequently a little lower than the rear wheel of the French artillery; but our front wheel being only about three feet nine inches, the increase of height in this wheel by the English, joined to the equal distribution of weight in the four wheels, occasions a greater facility of motion in their artillery than is to be found in ours. The carriages distinguished by the term *à la comtoise*, and known by the experience of trade to move with ease and facility, are constructed on the same principle as the English artillery carriages, the front wheels being of the same dimensions as the rear, and the whole four sustaining an equal proportion of the burden.

Fourthly; *Every carriage in the train answers for the conveyance of artillery-men.*—The limber, common to all the artillery-carriages of the English field-train, carries two ammunition-

boxes, upon which, with the assistance of a couple of straps, folded blankets are fastened, and these are then covered with tarpaulin, by which arrangement three gunners may always be seated on the limber. The ammunition-car is calculated to convey six gunners, three in front and the same number behind.

Fifthly; *Every facility for the storing of ammunition.*—Each ammunition-box, whether of the limber or of the body of the car, being so constructed as to be easily shipped and unshipped, and being of a manageable weight, may be stored or placed in the magazine, without the necessity of unpacking it. This is of importance in embarkations, in passing over mountains, rivers, &c.

Advantage of the new System of Draught.

In the Gribeauval artillery, the ammunition-box is placed between the cheeks of the gun-carriage; but the small number of rounds it contained, and the embarrassment occasioned by its removal to the limber on preparing for action, induced us to replace it by a large ammunition-box, permanently affixed to the limber. This plan had been previously adopted by our neighbours (we do not speak of the Spaniards, their artillery being an exact

copy of that of Gribeauval). A large ammunition-box, thus placed, was calculated to give greater weight to the limber, and consequently to render it less unsteady in manœuvring, when attached to the gun *(à la prolonge)*. However, the above-mentioned advantages arising from the construction of this limber among the Russians, Prussians, Austrians, Bavarians, and French, in the year 11 of the republic, were counterbalanced by the motion of the pole to the right or left, by its ploughing up the ground, or rising above the level of the horses' heads; and we have, therefore, returned to the limber of Gribeauval: these, I think, were the reasons for the change.

In placing the ammunition on the limber, and retaining the (*entretoise de lunette*) pintrail eye, the following circumstances were necessary to be attended to; to be able to turn the limber without letting the ammunition-box come in contact with the trail of the gun-carriage, and to move the limber with facility, when attached to the gun, or otherwise, the ammunition-box being either full or empty. To perform this last condition, it would only be necessary to cause the centre of gravity of the ammunition-box to fall upon the axletree; but then the pintrail being fastened into a description of splinter-bar *(sassoire)* placed very much in rear

of the axletree, on account of the room necessary for turning the limber, the pole with the front tree-bar *(la volée de devant)* could not form an equipoise to the weight of the trail acting on a point considerably behind the axletree of the limber. It was, therefore, found necessary to remove the pintrail nearer to the axletree, and the ammunition-box more towards the front. The Austrian limber approaches nearest the solution of the problem in question, on account of a second splinter-bar *(sassoire)* considerably apart from the little one, in which is fixed the pintrail; and the second splinter-bar always keeps the pole in its proper position, whether the ammunition-box be empty or full. However, the rear horses are not, in consequence, the less fatigued, when the unevenness of the ground forces the splinter-bar from its position underneath the cheeks; but, in a level country, the weight of the pole never falls upon the horses' necks; for the pintrail placed in the little *sassoire* is sufficiently near the axletree of the limber, to prevent the weight of the trail of the gun-carriage from throwing the pole up when the ammunition-box is empty; and the large *sassoire* is just far enough from the axletree of the limber to avoid the weight of the trail being overbalanced, when the ammunition-box is full. All this reasoning should be sup-

ported by calculations; but these may easily be made. I repeat, that this solution of the problem does not obviate the pressure on the necks of the horses, if the nature of the ground forces the splinter-bar to quit its usual position beneath the cheeks when the pole-straps or chains *(les chaînes d'attelage)* elevate the extremity of the pole; and besides, this great *sassoire,* when very much thrown forward under the cheeks, considerably incommodes the gunners in limbering and unlimbering. It was probably to obviate this last inconvenience, that the large splinter-bar of our limber, during the year 11 of the republic, was not placed so far under the cheeks; but, on the other hand, this limber was exposed in a greater degree to the disadvantages of draught, which we noticed above.

The Prussians have, foolishly, altogether abandoned the use of the second splinter-bar, and consequently their limber possesses a larger portion of imperfection than those we have just examined. When their ammunition-box is empty the pole is constantly above the horses' heads, though, when the front horses are in the act of pulling, it takes an horizontal position for a moment, and then flies back to its former elevated station, to the continual annoyance of the rear horses and of the driver. The Russian limber is as defective as that of the Prussian.

P 2

The English limber, with its system of draught, completely obviates the difficulties of the question; and the equipoise of the peculiarly constructed* shafts *(brancards-timons)* gives it at once the advantages of the pole and shaft, and this in the simplest manner. The centre of the ammunition-box may be said to pass almost close along the axletree, upon which also the trail of the gun-carriage partly rests. From whence it follows, that the movement of these shafts is almost unimpeded by any pressure, and that the rear horses have hardly any weight to sustain, but merely to draw. That the trail of the gun-carriage might rest upon the axletree of the limber, or nearly so, it was necessary to abandon the use of the †*entretoise de lunette*, and to substitute in its place a kind of strong eye-bolt, sufficiently prominent when placed on a massive hook, (the pintrail), fastened into the rear of the bed of the limber-axletree, to admit of the limber turning without touching the trail of the gun-carriage. The di-

* These shafts, which are commonly placed to admit of driving two horses abreast, may be easily shifted, when the roads become too narrow, and adapted to the draught of only one horse abreast.—*Tr.*

† The *entretoise de lunette* is the same as the pintrail-eye of the bracket-trail: but since the use of the block-trails, a strong circular piece of iron attached to the end of the trail forms, upon the improved plan, the pintrail-eye.—*Tr.*

mensions of the English wheel being one and the same, and its height greater than our limber wheels, if the cheeks of the trail had been retained, their distance asunder would not have left sufficient room for the turning of the limber; therefore it was thought advisable to substitute a solid piece of wood in their stead, and the cannon now rests upon two small cheeks of wood attached to this block-trail. The weight of the ammunition-box, and pressure of the trail of the gun-carriage, being almost entirely sustained by the limber-axletree, the improved English shafts *(brancards-timons)* have all the facility of motion which we were desirous of giving to our heavy and cumbrous ones. The English shaft-horse has only to bear the weight of the two shafts almost in a state of equipoise, and, consequently, is not prevented from trotting, *(as experience proves: see* p. 229.) The shafts are supported by means of a sort of back-band strap passing through the harness-saddle.

The harness adapted to these peculiar shafts *(brancards-timons)* serves equally well for the draught of one horse abreast. The collars employed by the English for the draught of carriages, with a fixed pole, such as those for the conveyance of military equipage, have a ring of 4⅓ inches in length, attached to the chain which binds the two iron hames of the collar; and in

this lengthened ring is a circular one, through which the chain, joining the head of the pole, passes.

Details of Construction.

The first wheels used in the new system were composed of felloes of double casing. This mode of construction was abandoned in 1812; and it is only considered of consequence to have the ends of the spokes slight and broad, by which less stress is caused to the nave, and the wheel is less liable to be forced into an elliptical shape. The nave of the wheel has very little play, and straining is consequently avoided. The iron axletree is always embodied in wood, and rendered as light as an attention to strength will allow of; and although ours is heavier, it is not stronger than the English axletree.

The elevating screw for the nine-pounder is fastened to the cascable, and is inserted into a circular screw, with produced radii, answering the purpose of handles, by turning which the gun may be elevated or depressed. The elevating screw has superseded the use of coignes, and, I believe, keeps the gun more steadily fixed in the direction given. The elevating screw of the English howitzer is similar to that

used in our battering train, except that it is pierced for a left-handed screw.

The circumference of the wheel is bound by pieces of iron, nearly touching each other, the ends of which are fastened on the felloes with four tire-nails, no screw-nails being used with the English wheel, which simply requires rivets at the extremities of the felloe. The head of the English rammers is smaller than that of ours; and the spunge-heads are enveloped in sheep-skin. The port-fire stick is constructed with a screw; and the port-fire clipper, affixed to the right of the gun-carriage, is immediately within the reach of the gunner, when he wishes to cut off the lighted end of the port-fire. All the ammunition boxes are covered with painted canvass. We have been given to understand that the windage of shot is reduced to half a line.

Observations.

This memoir does not contain the plan of the field-forge cart, and of the wheel car, but the construction of the forge-cart may easily be imagined. The body of the forge-cart is very similar to that of the ammunition car, except that the ammunition boxes are replaced by cases lying parallel to the wheel, and projecting as far over as the naves of the wheels

The space between these two cases is occupied by the bellows, and the forge is constructed in the rear of the carriage, being nearly similar to, but somewhat less than the forge used in the French field-artillery. The timber of the forge-cart and of the carriage for the conveyance of spare wheels, is the same as that in common use throughout the field-artillery; but the two ammunition boxes are exchanged for a single case intended to carry tools. The wheel car is calculated to convey three wheels, one behind by means of an axletree for this purpose, in the shape of a T, which passes through the grooves cut for the trunnions; the other two to the right and left of the carriage, by the contrivance of a short axletree, resting on a cleat of wood, placed between the cheeks of the carriage. These three wheels are lashed together with cordage, and the spare axletree is carried underneath the carriage.

The English military equipages are composed of two different kinds of carriage; the one with cut transoms* *(à brancards coupés)*, and rear

* *Brancards* appear to be pieces of wood laid parallel to the wheels, and forming part of the lower frame of the body of the waggon. By the term *brancards coupés* may be understood that piece next to the wheel, which is cut to admit of the wheel passing under in turning, as it often does as far as the waggon-pole. The translator is aware that the use of the English term

wheels of the same dimensions as that common to all the field-artillery, but with front wheels of only four feet in height. The front wheels in turning reach as far as the pole; and the bottom of the body of the waggon, though in reality constructed with four transoms, has the two exterior ones just mentioned cut for the passage of the wheels. The two intermediate transoms reach from one end of the carriage to the other. In the construction of the transoms there is some analogy between this carriage and the great covered waggon of the Austrians. The other description of carriage alluded to above has four wheels of nearly the same height, but smaller than the wheel in use in the field-artillery; those in front are calculated, in turning, to pass beneath the transoms.*

The improved state of the English field-artillery may be said to have taken its rise within

transom may be objected to; but as he has not been able to discover a word capable of rendering the French expression more correctly, he feels less anxious to avoid the imputation of technical inaccuracy, than to make himself intelligible to his readers.—*Tr.*

* It appears by the original, that the dissertation upon the superiority of the British over the French artillery, for which the author was indebted to M. Parizot, (chef-de-bataillon of artillery,) terminates with this passage; the subsequent remarks are from the author himself.—*Tr.*

the lapse of a few years; for in the year 1793 this branch of the military profession was still in its infancy. A carriage, made with shafts for a single horse abreast, conveyed the ammunition packed up in large deal boxes, and was thus intended to answer the purpose of a limber to the gun. The drivers were on foot, and each had to lead three horses.

From the year 1793 to 1800 shafts were laid aside in favor of the pole; gun carriages, limbers, and other artillery carriages, underwent improvement, and during the same period the corps of drivers was organized and mounted. On the renewal of hostilities in 1803, two-wheeled carriages were made use of to convey ammunition for the field-pieces; and were calculated, as well as the gun-limbers, to serve, in case of need, for the transport of the gunners. Carriages of a new form, attached to brigades of foot artillery, were appropriated for the conveyance of ammunition; the packing of which was likewise considerably improved. The horse artillery also quitted the old ammunition cars for those of an improved plan; the old being so heavy, as to make it necessary to leave one of the three ammunition boxes which they carried entirely empty. The construction of gun carriages also underwent essential improvement; and, lastly, the command of the field

train was totally given into the hands of artillery officers; from that epoch almost all innovations may be dated, and are ascribable to the activity which has ever since displayed itself in that department.

The English field-artillery differing essentially from that of other nations, and possessing very valuable properties, deserves to attract and fix general attention. Since the peace the French officers have made it their particular study; but, from the opportunities afforded by the war, the Hanoverians and Prussians have considerably had the lead. We have just seen a French artillery officer availing himself with eagerness of the first opportunity that offered to acquire a knowledge of the English system. When the occupation of France, under the name of alliance and protection, was made a cloak to acts dictated by the vengeance, and exactions wrung by the avidity of coalesced Europe, our most skilful officers of artillery and engineers could not be inattentive spectators of the equipment and discipline of the enemy's* army; they therefore considered these subjects atten-

* A general officer, when giving an account of the great military movements of 1818 in presence of the allied sovereigns, expressed himself in the following manner:—"I have very attentively observed the manœuvres of the artillery belonging

tively, and more especially with reference to the English artillery.* During "the hundred days" a train of six guns and two howitzers were sent by the British government into La Vendée, to encourage and support the civil war. Three years after, the royal government succeeded in obtaining uncontrolled possession of cannon which, without doubt, had previously been reserved to awe and contest the authority of the prince, at a favorable moment, under the shout of *Vive le Roi!—quand même......*

The pieces composing this train have been carefully studied; and from the beginning of 1819 the elementary principles have been defined, and materials that might tend to give a thorough knowledge of the good qualities and defects of this ordnance, have been every where sought and collected. Skilful officers were commissioned to examine these numerous

to the different powers; I have been struck with the appearance and splendor of the troops composing the army, and with the order and precision of their various evolutions; *but the English take the lead in every respect.*"—*Author.*

* The officers of the French garrison of Douai particularly distinguished themselves by the skill, energy, and activity, which they evinced in overcoming the difficulties naturally attendant on such a research occasioned by the distrust entertained on the part of the occupants of every observant Frenchman.—*Author.*

documents, to reconcile the contradictory opinions they might contain, to refute erroneous ideas, to solve all doubts which might still exist, and definitively to determine on what was worthy of imitation or rejection.

The report which contains the result of this laborious investigation does honor to the intelligence of the corps of French artillery; and it shows the fruits of the instruction which has emanated from the polytechnic school. The officer who drew up the report, the chef-de-bataillon Forceville, formerly educated at that school, points out the mathematical principles upon which the merits or defects of the gun carriage, limber, and system of draught for the train of artillery, should rest. It is a theory, the due consideration of which requires the union of various mechanical information, with experience of the effects produced by different modes of construction, of portage, and of draught, and of the evolutions and movements of cannon. It would be desirable that every branch of artillery should be examined in the same spirit of philosophy; for the union of several analyses, the result of reason and experience, would form a guide for a course of instruction, well adapted to complete the studies of the practical school for the artillery and engineers. The enlightened zeal of the general officers of these two

branches of the profession places it beyond doubt, that they would adopt this important improvement as soon as made known to them, and unite in wishes and exertions to fill up what has to this day remained a blank in our system of military education.

M. Forceville, after having laid down and demonstrated his general principles, founds upon them a comparison between the gun carriage and limber of the English and French field-artillery. His conclusions agree in general with those already made by M. Parizot, except with regard to the shafts of the limber. "The English artillery (says he) has reached its greatest perfection, principally in its system of draught, and the facility with which it limbers and unlimbers. But in adopting the limber with shafts, it is exposed to all the inconveniences arising from that mode of draught,—inconveniences which are likely to bring manœuvres *à la prolonge* into disuse, &c." MM. Baudin and Marcoux have endeavoured to remedy this defect without sacrificing the valuable qualities of the other parts of the system.

General Sharnhorst, in his "Manuel sur les Parties Pratiques de l'Art de la Guerre," has since 1804 given to the public some of the elements of the system; but the new edition of Adye's "Pocket Bombardier and Gunner,"

which appeared in 1813, contains, in some respects, more precise and enlarged details. During the same year, Great Britain furnished all the nations coalesced against us with an immense quantity of the *matériel* of war; she gave the Germans field trains of artillery, and at the same time transmitted to the officers, who were to have the management of them, tables of range, and instructions upon the use and exercise of the guns. In 1814 experiments were made at Glogau for the purpose of examining the properties of the limber, &c. At length there appeared in the Berlin Military Journal of 1818, eleven extracts from a manuscript on field-artillery, in which the author, Capt. Mathias, offers many details on the new English system. Such are the various sources from whence we have collected the facts and results which we have yet to lay before our readers.

Light artillery would be perfect if the gun could move as rapidly as the fleetest cavalry, and follow without retarding it in any of its evolutions; and this will be effected whenever (the gunners being mounted, or otherwise conveyed with the gun) the horses drawing the piece shall not be more impeded than those that carry a trooper with his arms and field equipment. This end, which may be considered

as hardly attainable, is what, nevertheless, we should endeavour to approach as nearly as possible. The piece that we conceive as the model of perfection must have this degree of mobility, and is as well calculated to serve as the *beau ideal*, by which we may compare and judge of the relative merits of the *matériel* of the artillery. According to some calculations, into the details of which we need not enter, Capt. Mathias comes to this conclusion, that from about *227 lb. to near 307 lb. is the greatest weight that the artillery horse should be compelled to draw; and from thence he assigns about 1707½ lb. as the maximum of weight in a field-piece for the draught of six horses, performing their evolutions upon level and firm ground, and with the rapidity of cavalry. The light six-pounder, with the improvements made by the English since the last

* These numbers, as given by the author, are 121 kilo. and 139 kilogrammes, which are respectively equal to 266.9502 lb. and 306.6618 lb. avoirdupoise, the maximum of weight for six horses, he makes amount to 774 kilo. = 1707.5988 lb. and seems to have multiplied the mean between 121 and 139 by six, for the calculation of the greatest weight for the draught of six horses, instead of taking 139, which he previously gives as the maximum of weight for one horse, and which therefore is the only just ratio to ascertain the maximum of weight for six. —*Tr.*

war, approaches the nearest of all the cannon employed by military nations to a gun of this weight.

As the weight of the different parts may enable us better to judge of the advantages which characterize the English six-pounder, we lay before our readers the following results, extracted from observations made by Capt. Mathias upon the field-pieces which he examined in 1813 and 1814; and we add analogous results taken from the French six-pounder, according to the *Aide-Mémoire*.

Six-pounder.	*English.*	*French.*
	lbs.	*lbs.*
Weight of the cannon	619·76	853·16
Carriage fully equipped	880·21	1176·54
Limber ditto	787·53	732·46
Thirty rounds of ball, and ten of grape or canister	217·96	,,
Ammunition-box, ball, and fifteen cartridges	,,	251·51
Four gunners conveyed with the piece . .	544·67	,,
Total weights	3050·13	3013·67

If we take into calculation, that the French field-piece only carries *fifteen* cartridges, whilst the English gun has forty complete rounds, and four gunners besides, we shall be struck with the advantage of this last system, by means of which so much that is desirable may be attained with so little increase of weight.

It has been asserted that the Wurtemberg six-pounder is the lightest of this calibre.

	lbs.
It weighs with thirty cartridges, without wheels and limber	2112·15
With the addition of the wheels and limber, constructed according to Sharnhorst	3296·92

With the six-pounder after the model of Sharnhorst, the weight, including ammunition, exceeds—

That of the English.	Of the Wurtemberg.	Of the supposed perfect Piece.
508·48 lbs.	470·25 lbs.	578·77 lbs.

By adding these numbers to the weight of the different six-pounders, for the purpose of comparison, the following table will be formed:—

	Wurtemberg, 6 pr.	Sharnhorst's Model.	English, light, 6 pr.	Supposed perfect Piece.
Total weight	3767·2 lbs.	3617·2 lbs.	3238· lbs.	2284·1 lbs.
Draught for each horse	627·8	602·8	539·	380·6

From hence it may be seen that the English six-pounder is the lightest of all the pieces of the same calibre. This lightness does not only proceed from the smaller quantity of ammunition upon the limber, but is principally owing to the smaller weight of the cannon, and a more

fortunate combination of advantages and disadvantages.

Notwithstanding the superiority which the English six-pounder possesses in point of facility of motion, we have seen that the British government substituted a nine-pounder in its place for the horse-artillery service, at the commencement of the campaign of 1815. But the reason of this is evident. The light six-pounder answered perfectly well during the war in Spain and Portugal, where the country is mountainous, and the principal roads few in number, and bad; but as soon as the English army cantoned in Belgium was destined to have a flat country, intersected by wide and beautiful roads, for the theatre of its operations, the six-pounders were replaced by the nine. The military events of "the hundred days" proved the excellence and foresight of this measure.

The train of nine-pounders in the horse-artillery have, independently of the men on horseback, two gunners seated upon the limber of the gun. The horses that are mounted may also be applied to the draught of the gun. The traces are folded against and in rear of the saddle; and the strap which answers the purpose of a collar does not chafe nor inconvenience the horse.

Nine men are the complement to each gun,

and may be ranked in the following order:—One serjeant commander of the gun, one bombardier (the next gradation of rank above a gunner) to guide and point the piece; first gunner to spunge the gun; second to put in the charge; third to clear the vent and prime, and (carrying for this purpose a slow match) to light the port-fire just previous to the word *fire* given by the bombardier; fourth to fire, and at the word *cease firing* to cut off the lighted end of the port-fire with the clipper fastened to the cheek of the gun carriage (these port-fires are thicker than our's, and last a very long time;) fifth, sixth, and seventh, to serve the piece with ammunition, &c.

In the foot-artillery, all the gunners, when occasion requires, are conveyed upon the limber of the piece and ammunition car; and in this manner are moved with a rapidity almost equal to that of horse-artillery. What an advantage does not this give to the English over the French gunners,—who, encumbered with their sabres, musquets, knapsacks, &c. cannot with celerity reach any point, however near, without being out of breath, and deficient in the necessary strength to work their guns!

As experience must decide, in the military art, the real merits of innovations, we conceive the following observations, by a general officer

of artillery, an eye-witness of the manœuvres performed by the English, with the other coalesced powers, in the general review which preceded their departure, will be found interesting:—"When the cavalry were drawn up in two lines, on the plain between La Selle and L'Ecaillon, and supported by masses of infantry, upwards of an hundred pieces of horse and foot-artillery were seen to issue at the same moment from the different bodies of troops, and move forward *with equal velocity* a hundred toises in front of the first line of cavalry.

"The affair commenced by a cannonade resembling a running fire; and the movements and evolutions of the artillery were executed with great order and precision. The facility with which the guns were limbered and unlimbered did not escape the notice of our artillery-officers. One of the brigades of foot-artillery met with an accident in passing, at the gallop, a very precipitous road. Having found the passage obstructed by a calash, the brigade dashed rapidly into a field on the left to avoid any delay; only one of the guns, however, was overturned, and but one of the gunners suffered from its fall; the piece was righted in an instant, and joined the brigade. The two lines of cavalry charged twice in succession, and, as if repulsed, rallied alternately behind each

other. The gunners then retiring rapidly with the limbers, deserted the guns, and presently after returned to the charge and recommenced firing. The passage of the Ecaillon, supposed to be defended by the enemy's army, occupying the villages, bridges, and all the important points of the position, suggested the plans and evolutions necessary for an operation of this importance. The passage being forced, the supposed enemy finding his left flank turned, and being pressed by the allies, commenced a retreat, contesting every foot of ground and defending every village, until he reached the camp on the heights of Famars. The artillery followed the troops through the steep valley of L'Ecaillon, and through the plain beyond (overcoming every obstacle) to the foot of the heights of Famars, arriving on the ground at the same moment as the rest of the army: this position is covered by a deep ravine difficult of ascent *which the artillery cleared like the cavalry.* Some carriages were overturned but quickly set upon their wheels again. Our artillery would not have surmounted this obstacle without much time and labor."

We shall compare the different calibres of the field-artillery, which may be reduced to the 12-pounder, 9, 6, and 3; but this last is scarcely used except in mountain-warfare.*

* The three-pounders destined for service in mountainous

Weight and Length of English Brass Field Guns.

	Length.			Weight.	If the weight of the ball be considered as 1, the gun will be in the proportion of
	In Calibres	*ft.*	*in.*	*lbs.*	
18-Pr. Light, new .	13·000	5	9	2016	112
12-Pr. Medium, new	16·872	6	6	2436	168
Ditto, Light, ditto	13·000	5	0	1344	112
9-Pr.				1512	168
6-Pr. Desagulier's med.	22·876	7	0	1368	226*
Ditto, Light	16·000	5	0	672	112
3-Pr. Desagulier's .	24·717	6	0	672	224
Ditto, Light, common	14·418	3	6	307	102⅓

Weight of Field Pieces when mounted, equipped and supplied with Ammunition, &c. including Gun-carriage, Limber, and Ammunition Car. (Adye.)

	Gun and Limber.	Amm. Car.
	lbs.	*lbs.*
12-Pounder	4704 . .	3248
9-Pounder	3296 . .	2912
6-Pounder, heavy	4200 . .	3080
6-Pounder, light	3080 . .	2912
3-Pounder, heavy	2912 . .	2576

countries are mounted upon wheels the breadth between which is four feet. General Allix, in a memoir written during his proscription, for the purpose of offering to France the system of artillery which he had lately framed for the kingdom of Westphalia, mentions that, in the year seven of the republic, the French army failed in an attempt to turn the Austrian army, and was afterwards beaten, from our guns being of too great a breadth to admit of their passing along narrow roads.—*Author.*

* This is in all probability an oversight, since the proportion will undoubtedly be found to be 6 : 1368 : : 1 : 228.—*Tr.*

The five and a half inch howitzer is employed in the field artillery; the heavy is brigaded with the heavy twelve, nine, and six-pounders, and the light five and a half inch howitzer is attached to the brigade of light six-pounders.

	Heavy. lbs.	Light. lbs.
Weight of the howitzers	1300 .	450
Weight of the howitzers, mounted, equipped, &c. } . .	4600 .	3057
Weight of their ammunition cars .	3057 .	3024

It will be seen, that the weight of the different kinds of howitzer is sufficiently proportionate to that of the guns to which it is attached; this being necessary to enable every part of the brigade to move with equal velocity. There is yet another howitzer of four and two-fifths inches calibre which is employed with the lightest description of artillery in mountainous and much intersected countries, and weighs only 349 pounds.

Principal Dimensions of the Howitzers.

		$5\frac{1}{2}$ inch. Inches.	$4\frac{2}{5}$ inch. Inches.
Total length		$26\frac{3}{4}$* .	22
Length of the bore		18·47 .	15
Chamber	Length	6·02 .	4·52
	Diameter at top . .	3·25 .	2·7
	Diameter at bottom	2·45 .	2·24
Powder in the chamber . . .		1 lb. . .	8 oz.

* Twenty-six inches and three-quarters, according to Adye; M. Dupin allows at most 26·25 inches. This is one of the trifling inaccuracies which have crept into the author's calculations.—*Tr.*

Ammunition for the Field Artillery.

	Round Shot Rounds.	Case Shot.			Total.	Cartridges.		
		Heavy.	Light.	Spherical.		*a.**	*b.**	*c.**
12-Pounder.								
Conveyed with the Gun	10	1	1	,,	12	12	,,	,,
Ammunition Car, In Front	24	4	4	,,	32	32	8	8
Ammunition Car, In Rear	28	2	2	8	40	32	,,	,,
Total -	62	7	7	8	84	76	8	8
9-Pounder.								
Conveyed with the Gun	26	3	3	,,	32	32	,,	,,
Ammunition Car, In Front	26	3	3	,,	32	32	,,	,,
Ammunition Car, In Rear	36	2	2	12	52	40	12	12
Total -	88	8	8	12	116	64	12	12
6-Pounder, heavy.								
With the Gun - -	40	5	5	,,	50	50	,,	,,
Ammunition Car, In Front	40	5	5	,,	50	50	,,	,,
Ammunition Car, In Rear	60	5	5	20	90	70	20	20
Total -	140	15	15	20	190	170	20	20
6-Pounder, light.								
On the Gun-carriage	8	,,	,,	,,	8	,,	,,	,,
On the Limber - -	32	5	5	,,	42	50	,,	,,
Ammunition Car, In Front	32	4	4	,,	40	40	,,	,,
Ammunition Car, In Rear	60	5	5	20	90	70	20	20
Total -	132	14	14	20	180	160	20	20
3-Pounder, heavy.								
On the Gun-carriage	12	,,	,,	,,	12	,,	,,	,,
On the Limber - -	40	10	10	,,	60	72	,,	,,
Ammunition Car, In Front	40	10	10	,,	60	60	,,	,,
Ammunition Car, In Rear	96	,,	,,	22	118	96	22	22
Total -	188	20	20	22	250	228	22	22
3-Pounder, light.								
On the Limber - -	24	6	,,	,,	30	30	,,	,,
Ammunition Car - -	44	8	,,	8	60	52	8	8
Total -	68	14	,,	8	90	82	8	8

* The cartridges *a* are those of the full charge; the others are diminished charges. For a 12-pounder, $a=4$ lb.; $b=1$ lb.; $c=4\frac{1}{2}$ oz.:—for a 9-pounder, $a=3$ lb.; $b=14$ oz.; $c=3\frac{1}{2}$ oz.:—for the heavy and light 6-pounders, $a=2$ lb.; $b=12$ oz.; $c=2\frac{1}{2}$ oz.:—for the heavy and light 3-pounders, $a=1$ lb.; $b=8$ oz.; $c=1\frac{1}{2}$ oz.—

Ammunition for 5½-inch Howitzer.

	Common Shells.	Case Shot. Common.	Case Shot. Spherical.	Carcasses.	Total.	Cartridges. 1.	Cartridges. 2.	Cartridges. 3.
5½ in. Howitzer.								
Limber - - - - -	16	4	,,	,,	20	20	16	,,
Ammunition Car — In Front	22	,,	,,	,,	22	22	22	,,
Ammunition Car — In Rear	20	4	8	4	36	36	20	8
Total -	58	8	8	4	78	78	58	8

Quantity of Ammunition to be carried by the Ammunition Waggons according to the latest Regulation of the last War.

	Round Shot.	Case Shot. Heavy.	Case Shot. Light.	Case Shot. Spherical.	Common Shells.	Carcasses.	Total.	Cartridges.
12-Pr. medium . .	60	6	6	8	,,	,,	80	80
9-Pr.	82	9	9	10	,,	,,	110	110
6-Pr. heavy or light	112	12	12	14	,,	,,	150	150
3-Pr. ditto . . .	210	23	23	24	,,	,,	280	280
5½-Inch howitzer .	,,	,,	8	8	60	4	80	80

The seventeenth report of the Commissioners of Military Inquiry contains a statement of the equipment of brigades of foot artillery in August, 1810, and also gives a plan of what was then determined to be the future regulation on this head. We shall endeavour to simplify these statements without suppressing any essential part.

Formation of Brigades of Foot Artillery (1810.)

Each brigade of foot artillery consists of: *Artillery:* one captain, one lieutenant, six under-officers, and sixty gunners. *Field Train:* one lieutenant, one serjeant, three* corporals, one trumpeter, one farrier, one smith, one wheel-wright, one harness-maker, and the number of *Drivers* contained in the following statement.

Brigade of 12-Pounders.	Number of Pieces, Ammun. Cars, &c.	Artillery Drivers.	Horses. Saddle.	Horses. Draught.	Horses. Total.
12-Pounders	5	15	0	30	30
5½-inch Howitzer, heavy . .	1	3	0	6	6
Ammunition Cars: For 12-Prs. .	5	15	0	30	30
Ammunition Cars: For 5½-in. Howit.	1	3	0	6	6
Reserve Ammunition Cars: For 12-Prs. .	5	0	0	0	0
Reserve Ammunition Cars: For 5½-in. Howit.	1	0	0	0	0
Spare Gun-carriage, carrying spare Wheels (Wheel-Car) with the Harness-maker, Wheelwright, and their tools, &c.	1	2	0	4	4
Carriage for the conveyance of Camp-equipage, &c. . .	1	2	0	4	4
Forge-cart	1	2	0	4	4
For the Officers and Under-Officers	0	6	11	0	11
Reserve	0	9	1	8	9
Total . . .	21	57	12	92	104

* Only two corporals are attached to the brigade of light six-pounders.—*Tr.*

Brigade of 9-Pounders, or Heavy 6-Pounders.	Number of Pieces, Ammun. Cars, &c.	Artillery Drivers.	Horses. Saddle.	Horses. Draught.	Horses. Total.
9-Pounders	5	15	0	30	30
5½-inch Howitzer, heavy . .	1	3	0	6	6
Ammunition Cars — For 9-Prs. . .	5	10	0	20	20
Ammunition Cars — For 5½-in. Howitz.	1	2	0	4	4
Wheel-Car, carrying the Harness-maker, Wheelwright and their tools, &c.	1	2	0	4	4
Carriage for the conveyance of Camp-equipage	1	2	0	4	4
Forge-cart or Waggon . .	1	2	0	4	4
For the Officers and Under-Officers	0	6	11	0	11
Reserve	0	8	1	7	8
Total . . .	15	50	12	79	91
Brigade of Light 6-Pounders.					
6-Pounders, light	5	10	0	20	20
5½-inch Howitzer, light . .	1	2	0	4	4
Ammunition Cars — For 6-Prs. . . .	5	10	0	20	20
Ammunition Cars — For 5½-in. Howitz.	1	2	0	4	4
Wheel-Car, carrying the Harness-maker, Wheelwright and their tools, &c.	1	2	0	4	4
Carriage for the conveyance of Camp-equipage	1	2	0	4	4
Forge-cart or Waggon . .	1	2	0	4	4
For the Officers and Under-Officers	0	5	10	0	10
Reserve	0	7	1	6	7
Total . . .	15	42	11	66	77

CHAPTER II.

BATTERING TRAIN.

In a war of sieges, and even in the attack of temporary fortifications capable of resisting the efforts of field artillery, the English employ eighteen and twenty-four pounders. The following calculations of the length and weight of brass guns of these calibres are extracted from Adye.

	Length of the Gun.		Weight.
	In Calibres.	In ft. in.	In lbs.
24-Pr. Heavy	19·574	9 6	5945
24-Pr. Medium . . .	16·483	8 0	4678
24-Pr. Light	10·302	5 0	1889
24-Pr. Light, new . .	13·000	6 3	2688
18-Pr. Light, new . . .	13·000	5 9	2016

In the Spanish war, the English, being pressed for time, wished to obtain possession, at any rate, of some strong fortresses before the French armies could attempt their relief. They attacked these places with formidable batteries, in which they employed iron instead of brass cannon, and without waiting to complete their second parallel, they took their station at four hundred and fifty, five hundred and fifty, and even

seven hundred yards, from the points which they were desirous of breaching. Their iron guns threw the shot with greater force than the brass, and were, moreover, capable of sustaining the most unremitted fire without injury:* the following table will show the effects of the artillery employed by the British.

Memorable Sieges in Spain.

Range of Fire.	Sieges.	Number of Pieces.	Number of Rounds.	Duration of Fire.	Extent of the Breaches. 1st.	2d.	3d.
				Hours.			
From 450 to 560 yards.	Ciudad Rodrigo.	18-Pr. 2	565	$32\frac{1}{2}$			
		24-Pr. { 23 / 7 }	8950	$32\frac{1}{2}$ 17			
		Total - 32	9515		Feet. 100·06	Feet. 30·18	Feet. „
From 600 to 700 yards.	Badajoz.	18-Pr. { 8 / 6 }	13,029	104 78			
		24-Pr. . 12	18,332	91			
		Total - 26	31,861		150·09	90·22	40·03
600 yds.	St. Sebastian.	24-Pr. . 20	6,000	62	328·08	98·42	„

* The system of attack resorted to by the English, during the Spanish war, consisted in battering from a distance, breaches of such an extent, that the most valorous enemy were unable to defend them. Such a system was only practicable against works the masonry of which was uncovered. Nevertheless the English paid dearly for their success; and French valor repeatedly defeated their efforts before Badajoz and St. Sebastian. —*Author.*

The English have very much increased the excellence of their iron cannon; and by being more exact in the proof, the foundries have, since 1797, considerably improved. The Carron foundry seems to enjoy the highest reputation, and that of Mr. Walker may be considered perhaps to have the next claims to public notice. By the use of improved machinery and tools, the surfaces of the bore, of the vent, and of shot and shells, &c. have been brought nearer mathematical precision. The English have made similar progress in the improvement of their powder, and consequently possess a battering train of their own creation, more formidable, from the nature of its materials, than that of any other people.

At St. Sebastian, the vents of the cannon increased from use to such a degree as to be wide enough to admit two or three fingers. In all other respects these pieces were in good condition, and they preserved their correctness of bore so well, that at the close of the siege, they were fired over the heads of the besiegers, then at the breach, with sufficient precision to cannonade the besieged behind an intrenchment thrown up at a short distance from, and very little above the assaulting troops.

In September and October 1813, the Master-general of the Ordnance, being informed of

what was observed to be the state of the guns employed at the siege of St. Sebastian, gave directions to prove four iron four-and-twenty pounders, in order to ascertain the number of continued rounds capable of being fired from cannon of this kind without their sustaining injury.

The guns destined for this proof were nine feet long, and differed in other respects as follows;

	lbs.	
1st. From Walker's foundry weighed	5379·07	common vent.
2d. From the Carron foundry . .	5435·22	common vent.
3d. Ditto . . ditto	5415·23	wrought iron vent.
4th. Ditto . . ditto	5421·23	copper vent.

The pieces received the full charge for twenty-four pounders, composed of eight pounds of powder, contained in a paper cartridge with a flannel bottom, a twenty-four ball, and two wads of junk of the same calibre.

The following table will show the result of the proof.

Effects of Firing in Widening the Vents

Days.	Rounds	Time used.			Of Cannon made at								Thermometer.			
					Walker's.		The Carron Foundry.						21st, 22d, 23d, September.		11th, 12th, 13th, October.	
					Common Vent.		Common Vent.		Wrought Iron Vent.		Copper Vent.		Heat of			
	No.	Between each round.	To load and fire.	For examination.	Outside Diameter.	Diameter within the Gun.	Outside Diameter.	Diameter within the Gun.	Outside Diameter.	Diameter within the Gun.	Outside Diameter.	Diameter within the Gun.	The Atmosphere.	The Gun.	The Atmosphere.	The Gun.
		min.	min.	min.	inches.	inches.	inches.	inches.	inches.	inches.	inches.	inches.	deg.	deg.	deg.	deg.
1st.	25	4	96	24	·16	·12	·12	·20					64	71	53	58
	25	4	96	114	2·68	·12	1·50	·71	Incr	ease	Incr	ease	67	79	53	66
	25	4	96	24	2·68	1 81	1·69	1·30	scar	cely	imperc	eptible.	68	78	58	63
	25	4	96	firing ceased.	3·07	2·48	1·89	1·50	visi	ble.			60	71	56	64
2d.	50	3	147	24	4·06	3·07	2·87	1·97	1·30	·43	ditto	ditto.	68	83	56	64
	50	3	147	72	4·13	3·46	3·07	2·28	1·89	·79	·12	ditto.	62	92	56	72
	50	3	147	firing ceased.	4·45	4·25	4·06	3·03	2·28	·79	·79	·31	62	90	58	87
3d.	50	3	147	24	6·42	4·45	5·04	3·07	3·46	1·10	·79	·39	66	82	58	78
	50	3	147	72	8·58	7·01	5·24	4·65	3·86	1·18	3·15	·51	66	92	56	72
	50	3	147	firing ceased.	9·84	8·19	7·01	4·84	5·43	3·66	3·27	·67	62	89	55	

On the 21st, 22d, and 23d of September our hundred rounds per gun were fired in this manner, each of the cannon having common iron vents. The bore of these pieces was examined, and was found not to have sustained any injury, except towards that part occupied by the ball, where it was a little furrowed. The vents continued, however, to increase; but the enlargement of those of wrought iron was so imperceptible, that hopes were entertained of their being capable of great resistance. The report made on this subject recommended, first, that iron cannon intended for sieges, should have their vents strengthened with wrought iron before they were issued for service; and secondly, that a like quantity of wrought iron for vents should be sent to repair those guns which might be injured by long and constant use.

But, from the result of experiments made on the 11th, 12th and 13th of October, with a piece of the same calibre, having a vent of pure copper, this last method of construction is apparently entitled to a decided preference; unless perhaps, in case of a demand for artillery, it may appear advisable, for the sake of greater certainty, particularly as to the adherence of the copper of the vent to the iron of the cannon, to send a certain number of guns of each description of vent.

After the capture of St. Sebastian in 1813, twenty-three iron twenty-four-pounders having been repaired in the vent were left in that fortress; but fifteen pieces of the same calibre, which had suffered most from constant use, were sent to Woolwich, where they underwent a regular examination. The bore of the guns had scarcely sustained any injury; and the enlargement of the vent was the only circumstance that rendered them unserviceable. The size of the furrows made by the ball near that part of the bore from whence it is propelled, was, at most, ·075 of an inch, and in some other places only ·024 of an inch; and the whole space wherein any injury was discernible scarcely exceeded from 2·3 to 3 feet, the bore at the mouth being almost imperceptibly grazed.

It is worthy of remark that, during the siege of St. Sebastian, the copper vents of four eight-inch howizers were found to be much more enlarged than the vents of two iron sixty-eight-pounder carronades of the same diameter, both descriptions of ordnance having been charged with the same quantity of powder, and fired with equal frequency. This fact, in seeming contradiction to the experiments made at Woolwich, shows the necessity of instituting a

fresh series of inquiries upon a subject of such extreme importance.

Having just spoken of iron sixty-eight pounder carronades, it may be proper to observe that the English, in a war of sieges, make use of this ordnance mounted on field carriages, instead of the brass eight-inch howitzer, as both are of the same calibre. The sixty-eight pounder carronade weighs fifty-nine times the weight of its ball.

We shall give more enlarged details on iron guns and carronades when we have occasion to treat of marine artillery: *(Naval power of Great Britain, &c.)*; and, for the present, it may suffice to lay before our readers a table of the weight of the iron guns employed at sieges, and mounted upon field carriages.

Calibre.	Length.	Weight: Of the piece.	Weight: Of the Carriage and Limber.	Total Weight.
pr.	*Feet.*	*lbs.*	*lbs.*	*lbs.*
24	9·51	5543·17	3127·16	8670·33
18	8·99	4479·82	2853·79	7333·61
12	8·99	3580·14	2692·67	6272·81
12	6	1763·2	2048·81	3812·01
Howitz. 5½ in. = 24		1343·33	1992·31	3335·53

Howitzers.

The English, in a war of sieges, make use of brass eight and ten inch howitzers: the following are the principal dimensions.

Howitzer.				Chamber.			
					Diameter		
Nature.	Length.	Weight.	Length of Bore.	Length.	At Top.	At Bottom.	Charge of Powder.
Inches.	*Feet.*	*lbs.*	*Feet.*	*Inches.*	*Inches.*	*Inches.*	*lbs.*
10	3·96	2898	2·49	12·6	5·78	4·13	7
8	3·08	1440	2·06	8·6	4·6	3·4	3·5

Excellent iron five-and-a-half-inch howitzers, in length equal to six times their own calibre, or 3·25 feet, have been lately cast at Woolwich. In 1819, there were five hundred new five-and-a-half-inch howitzers of cast iron, each weighing 1344 pounds, in the arsenal at Woolwich. These pieces, from having conical chambers so constructed that the diameter towards the bottom suffers very little contraction, whilst that at the top, or entrance of the chamber, is the same as the diameter of the bore, are far preferable to brass howitzers, can contain a much larger charge, and throw a shell to a distance considerably greater.

Mortars.

We have little to say upon the English mortars, and shall therefore confine ourselves to giving the principal dimensions of both kinds, brass and iron.

English Mortars for the Land Service.

Calibres.		Weight.	Length.	Powder contained in the Chamber.	Range at 45 Degrees.
		lbs.	*Feet.*	*lbs.*	*Yards.*
13-inch	Brass	2810	3·625	9·75	2100
	Iron	4100		9.5	
10-inch	Brass	1173	2·75	4·63	1900
	Iron	1798		4·5	
8-inch	Brass	484	2·145	2·00	1600
	Iron	907		2·25	
5½-inch	Brass	132	1·355	·563	1200
4⅖-inch	Brass	95	1·125	·28	1000

Before mortars can be received, their exterior parts must, on no account, deviate from the prescribed dimensions; for eight-inch howitzers and mortars no variation exceeding one-tenth of an inch, and for those of cohorns not more than $\frac{1}{24}$ of an inch is allowable. The diameter of the bore and chamber must not vary from the true proportion more than $\frac{1}{50}$ part of an inch. The howitzers and brass mortars are discharged twice, loaded each time with an iron shell, and their chambers full of powder: the former are mounted on their carriages, and fired with an elevation of twelve degrees, the latter on their proper beds, with an elevation of seventy-five. The iron mortars are proved upon their iron beds, with as large a charge of powder as the chamber will contain, and an iron ball equal in diameter to the shell.

Mortars and howitzers of small calibres will be rejected, if cavities in the chamber of $\frac{1}{10}$ of an inch and upwards, or flaws in the bore of $\frac{3}{20}$ of an inch be discovered; and a cavity of $\frac{3}{20}$ of an inch in the chamber, or of $\frac{1}{5}$ of an inch in the bore of an eight-inch howitzer, is conceived sufficient to warrant the rejection of the piece as unfit for service.

CHAPTER III.

Late Experiments made with the Ballistic Pendulum in the Arsenal at Woolwich.

Colonel Mudge, lieutenant-governor of the academy at Woolwich, Colonels Miller and Griffiths of the artillery, and Doctor Gregory, specially charged with the management of the theoretical part, commenced in the month of July, 1811, and continued, Doctor Hutton's beautiful experiments upon the measurement of the initial velocity of balls by the ballistic pendulum.

Colonel Miller, who is superintendant of the construction of gun and ordnance-carriages in the arsenal at Woolwich, directed the making of a new pendulum, much larger and a great

deal more perfect, than those previously employed in ballistic experiments. In the formation of this pendulum, many difficulties were necessarily to be overcome: first, to suspend at the end of a long lever or rod, a mass of seven thousand four hundred pounds weight; secondly, to give the axis such facility of motion, as not in any manner to impede the oscillations of the pendulum; thirdly, to impart a sufficient solidity to the whole to prevent jerks, concussions, or in fact any irregular movement, arising from the action of the pendulum. These difficulties had not been removed in former experiments. Doctor Hutton's pendulums were supported by a description of wooden gin, resting on three legs. This plan afforded so little stability, that the whole was most violently shaken whenever the pendulum was set in motion by the ball, and, consequently, all observations were, more or less, liable to uncertainty.

In the spot chosen for the late experiments two paralle walls were built 19·68 feet high, 18·04 feet long, and 9,02 feet distant from each other; and the upper part of these walls was joined by a wooden frame-work, supported at the sides and underneath by solid rafters. This frame-work has two wooden bolsters, wherein are fixed the iron rests which sustain the axis of the pendulum; the whole of this carpentry

is also covered by a roof, with two small windows cut near the top of each wall, for the purpose of admitting the light to the axis of the pendulum, and of giving an opening for the escape of the smoke, which is thrown and collected underneath the roof, whenever the cannon used for the experiment is fired. The two rests or supports for the axis are of cast iron; and the upper part of each terminates in a hollow, formed by two inclined planes having an equal declivity, but in contrary directions. In order that the oscillations of the pendulum may be true, the end of the axis is furnished with two blades, not exactly sharp or cutting, because they would then be quickly blunted; but formed with a curve described by a very small radius, and made of the hardest steel.

Before the pendulum is put in motion, a little oil is poured upon the inclined planes of the iron rests; and by these means the friction between the blades of the axis and the rests, which might, otherwise, be very considerable, is rendered imperceptible.

The pendulum is formed of several strong pieces of wood laid along side of each other, and joined by means of large cylindrical tenons, which fit into mortises cut in the adjacent pieces. This excellent method of uniting pieces of wood into one body, invented by General

Bentham of the artillery, for connecting the parts of a mast, perfectly answers the end proposed. In fact, when a ball strikes the centre of one of the pieces of wood composing the pendulum, the piece struck will be found, from the junction of the parts being so perfect, not to have been driven from its proper position more than $\frac{1}{25}$, or at most $\frac{1}{12}$ of an inch, notwithstanding the violence of the shock.

The block of wood, in which the ball should enter, is in the middle of the parallelopipedon which forms the pendulum. A certain number of balls may be fired into this piece, provided attention is paid each time to the increase of weight in the pendulum, and its further tendency towards a quiescent state, as every additional ball is lodged in it. The pieces of wood forming the body of the pendulum are bound by four collars of iron, the rectilineal parts of which are joined together with very solid screws. The suspension of the pendulum is effected, first, by two very broad and flat rods of iron, descending vertically from the axis as far as the centre of the lateral faces of the pendulum (when in a quiescent state); secondly, by four round rods of iron, passing diagonally from each upper angle of the pendulum to the extremity farthest from the axis, where they are fastened with screws. This system of construction possesses

the advantage of resisting all lateral vibrations, even if a ball should strike a little to the right or left of the vertical plane, which is perpendicular to the axis, and divides the pendulum into two equal and symmetrical parts.

When the pendulum was constructed and suspended, the means were yet to be discovered by which its oscillations could be measured; this was effected in two different ways. Above the axis is placed an upright metallic shaft about two feet in length, and acting upon the index to the graduated arc of a circle of brass, placed in a plane perpendicular to that of the axis of the pendulum. The upper end of this metallic shaft is traversed by a screw, by means of which the index is gradually brought to the zero of the graduation just before the experiment is made. The index encloses the graduated arc like a sheath, and has a small spring which, by pressing against the upper part of the circle, prevents its slipping off from any accidental cause.

When the projectile enters the pendulum, it propels this last a certain distance out of its vertical position; and the metallic shaft, acted upon by this motion, shoves the index forward. As the velocity of the pendulum ceases the moment it reaches its highest elevation, so also does the impulse communicated by the metallic

shaft to the index, discontinue. The gentle friction caused by the close adjustment of the index to the graduated arc (and by the small spring above-mentioned attached to the index), is sufficient to resist the slight impetus previously communicated; and, consequently, the index remains exactly where the metallic shaft or needle first began to recede. This may be placed beyond doubt by observing, as I did, that, at the second oscillation, the needle returns so close to the index as scarcely to leave any discernible space between them. After the second oscillation, however, the velocity of the pendulum continues to diminish, and every successive vibration falls short of the elevation of the one previous; but this loss of velocity is extremely slow. Thus, commencing with an oscillation, the measure of which was five degrees, the pendulum, after having made sixty vibrations forward and sixty returns in one hundred and fifteen seconds, was found only to have lost forty minutes in the measure of its oscillations; which would allow two-thirds of a minute for every oscillation,* sup-

* As it is only in the ascent of the pendulum that the index is acted upon by the metallic shaft or needle, a second oscillation is not reckoned until the needle returns towards the index, and, therefore, the descent of the pendulum does not enter into calculation.—*Tr.*

posing the loss to be uniform during the whole of the time specified.

It is easy to see the reason of so trifling a diminution in the extent of the oscillations, notwithstanding the make of the pendulum is so little advantageous to the continuation of motion. The resistance of the air is proportionate to the space gone through by the whole of the pendulum in its vibrations; whilst the degree of impetus imparted to the pendulum is (*cæteris paribus*) proportionate to its size. Thus, in the movement of two similar pendulums, having a and A for homologous dimensions, the proportion of resistance caused by the air in a given period of time may be represented in each by $\frac{A^2}{a^2}$; and the relation in the quantity of motion may be put down at $\frac{A^3}{a^3}$. The proportion then between the two pendulums in the resistance of the air to the quantity of motion may be shown by $\frac{A}{a}$, which, of course, will be encreased in the same ratio as A becomes greater, and a less.

Besides the needle above the axis, for the measurement of the oscillations, a second is placed underneath the pendulum, in such a manner, that when the pendulum is at rest, this needle points along the imaginary vertical line, supposed to pass through the centre of gravity of the pendulum, and the middle of the axis of

suspension. An arc of a circle, composed of solid wood, with a groove, filled with tallow, and graduated on each side, is placed in the plane, over which the second needle, just mentioned, passes, and forms a radius to it, so that the end of the needle, when in motion, makes a furrow in the middle of the circular mass of grease, lying between two graduated edges. The first oscillation of the pendulum being the greatest, the furrows made by the needle continually decrease, and are, consequently, confined within the extent of the first, the whole length of which will show the amplitude of the first oscillation of the pendulum.

One person measures the amplitude given here, whilst another notices that shown upon the brazen arc by the upper needle; both these observations must coincide, the one serving to corroborate the other. In order to determine the extreme length of the furrow, made in the grease by the lower needle, a little rule or square is employed, with a projecting side, which glides along one of the graduated edges of the solid wooden arc; and the second side of the square or rule, with its centre touching the extremity of the curve traced upon the grease, should indicate the same number of degrees on both the edges of the wooden arc.

The distance from the axis of suspension to

the centre of gravity, is about eleven feet; and the centre of oscillation about the same number of inches farther from the axis: the space between these two centres contains the point towards which the centre of the ball should be propelled. Upon the front face of the pendulum a vertical line is drawn, the plane of which would pass through the centre of the axis, and divide the pendulum into two equal parts; and upon the right and left of this line, near the edges of the front face, are two graduations, cut vertically. An horizontal line is made to pass from one graduation to the other, through the corresponding points of division, in such a manner, as to be perceptibly equidistant from the centres of gravity and of oscillation. Afterwards a leaden plate, of about half an inch in thickness, and a foot square, divided into four little squares by two straight lines, each parallel to its opposite sides, is nailed upon the front face of the pendulum in such a position, that the two lines thus drawn upon it, may coincide with the vertical and horizontal lines already traced upon the front face of the pendulum: these preparations being finished, that part of the experiment connected with the firing may be commenced.

If the weight of the pendulum constantly remained the same, it would suffice to have once

ascertained, by experiment, the position of the centres of gravity and oscillation. But the property of wood, alternately to imbibe and lose considerable moisture, renders it necessary, previous to commencing fresh experiments, to determine anew the position of the centre of oscillation, and the momentum of the vis inertiæ of the pendulum, or its tendency to a quiescent state. This is done by making the pendulum oscillate a sufficient number of times to ascertain, with exactness, the mean duration of the oscillations which, from the smallness of the amplitude given them, may be considered isochronal, that is, of equal duration.

The state of the barometer must be accurately observed each time, previous to firing; for the initial velocity of the ball will be either greater or less, according to the resistance which it meets from the air, when leaving the bore of the gun; and this resistance must be materially influenced by the density or tenuity of the atmosphere. The variation of the barometer has been known to occasion an alteration equal to a tenth of the whole resistance of the air; and, as Doctor Gregory observes, even during serene, and apparently settled weather, this change may amount to a fiftieth. In fact, as we have already said, these variations in the state of the atmosphere change the weight of

the pieces of wood composing the pendulum; and this must necessarily have an influence upon the proportion of motion communicated to the pendulum by the ball in its initial velocity.

It is not less essential to notice the rise and fall of the thermometer. First, the temperature of the air about, and near the pendulum, should be observed, because heat has a powerful effect upon the length of the metal, which is employed in the suspension of the pendulum, and because it is interesting to compare the variations of heat with those in the duration of the oscillations of the pendulum. Secondly, after every shot, a thermometer is introduced into the bore, as far as the breech, in order to ascertain to what height the temperature has been raised there, by the explosion. As the pressure, humidity, and temperature of the atmosphere may vary considerably, during an experiment which often lasts several hours, the same observations are repeated at the commencement and at the conclusion.

We shall now notice the precautions used in loading and firing the pieces, with which the experiments are performed. These guns are mounted on carriages similar to those of the field pieces described in the first chapter of this book. Lines are marked upon the upper part of

the flat moulding* of the breech, and upon the swell of the muzzle: first, in a direction the vertical plane of which would pass through the axis of the piece; secondly, to the right and left, the plane of which would cut the axis of the gun, and be parallel to the axis of the trunnions. Three lines, running in two planes perpendicular to one another, are thus obtained for the guidance of the eye in taking aim. The platform, on which the carriage of the cannon rests, is in a plane parallel to the axis of rotation of the pendulum, and has a slope equal to $\frac{1}{24}$ of its length. This platform is constructed with boards of the common dimensions, laid perpendicularly to the direction of the recoil. Before the piece is loaded, the powder which is to be used must undergo a proof; and for this purpose two ounces are carefully weighed, with which afterwards a small proof cannon is charged, being the same as that employed by Doctor Hutton in his experiments. This little cannon is supported by two iron shafts, uniting upon an horizontal axis, terminated by two small trunnions, which turn in two metal grooves (or cap squares) let into the side-pieces of a little frame of carpentry. Nearly in the middle of

* Upon that part close to the breech of the gun known by the name of the "Base ring and Resistance."—*Tr.*

these two pieces, or shafts of iron, is fixed an arc of a circle, having its centre upon the axis of rotation of the small proof-cannon, or éprouvette. This arc is graduated; and the index which glides along it, is fixed to the end of a moveable radius, proceeding from the axis, and forming, with a second iron shaft, a kind of bent arm or lever. Before the system is put in action, the moveable radius is brought round, until it conducts the index to the zero engraved upon the arc. A little screw traverses the end of the iron shaft, forming one part of the bent arm, (the movable radius being the other,) and is moved along until it just touches a small metallic plate, fastened upon the wooden frame-work which sustains the whole system.

Upon loading this éprouvette, a gunner takes hold of it by the chase, raises it perpendicularly, and, by means of a ladle, carefully lodges the powder at the bottom of the bore; afterwards, nothing more is conceived necessary than to press the powder a little with the rammer, which he does, and lets the cannon decline gently into its horizontal position. Then, the situation of the index upon the graduated arc is fixed by means of the screw, the action of which we have already explained. A small prepared line having been previously introduced into the vent of the éprouvette, is lighted

with a common match; and when the fire reaches the vent, the powder explodes, the recoil causing the piece to revolve round the axis of suspension, the trunnions. Both branches of the bent arm, or lever, remain immovable; the one resting against one of the traversing pieces or bolsters of the carpentry, and the other, to which the index is affixed, continuing in the position given it. The graduated circle fixed upon the iron shafts which support the cannon, rises with the gun, and glides along the index, until the first oscillation ceases; and, at that point, the arc of the circle, with the cannon, commences a retrograde movement; but the index being adjusted on the arc with much precision, adheres sufficiently to carry along with it the bent arm, or lever. As, after the first oscillation of the cannon, every subsequent vibration continues to decrease, the movable radius, which conducts the index, is each time less inclined from its vertical position, whilst, on the contrary, the other branch of the bent arm equally falls short in its downward vibrations. Thus the screw will no longer remain in contact with the metallic plate which it touched in the beginning; and nothing can, therefore, displace the index from its position on the graduated arc. It might be feared here, as well as in the experiments made with the large pendulum, that the

index would not mark the exact amplitude of the first oscillation; but whoever witnesses the experiment, cannot entertain any doubt on this head. At the second oscillation, the screw returns so near to the metallic plate, which it did not quit before the end of the first oscillation, that if there be any inaccuracy, it must be quite imperceptible.

It is evident, that (cæteris paribus) the number of degrees observed to be in the first demi-oscillation will indicate the force of the powder employed; according to the known principle, *that the number of degrees passed over by the pendulum, in a very small demi-oscillation, is proportionate to the square of the primitive force used to make it oscillate through that arc.*

This proof of the powder is repeated three times in succession; and the results obtained by each proof are carefully noted in the table of experiments. The next step is to load the cannon, which propels the ball into the ballistic pendulum. The powder, weighed with scrupulous nicety, is emptied into a case of very fine grey paper, and closed by means of a cover of the same kind; the weight of the paper is carefully ascertained. This cartridge is introduced into the charging cylinder of the piece, and pressed home with the rammer, without concussion; the ball is then put in,

and, with equal care, pressed against the cartridge. A wire of about $\frac{1}{24}$ of an inch in diameter is fastened over the surface of the ball, in such a manner as to describe two complete circles crossing each other at right angles. The intention of these wires is to increase the diameter of the ball, so as to fill up the windage, and prevent the rotation and irregularity of movement which it causes; by this means the shot is fired with the greatest possible precision. We must not forget to observe, that the surface of the ball is previously polished, and rectified, if its spherical form should be at all defective. After having pricked the cartridge, a tube is introduced into the vent, and the piece is ready to be fired.

The cannon is levelled so that, first, the upper line of sight may exactly cover the vertical line which divides the front face of the pendulum; and secondly, that the two lateral lines of sight may pass through the straight horizontal line drawn along the leaden plate, and extending from one side to the other of the front face of the pendulum: this renders the direction of the ball perfectly sure. The match is now applied; and the ball passes through the plate of lead which it partly drives in, and then buries itself in the piece of wood occupying the centre of the pendulum. The hole made by the ball in the plate

of lead is perfectly circular, and appears as if it were cut with a sharp instrument. From this regular form, the position of the centre of the opening may be exactly determined, and is defined: first, by the distance which this centre is above or below the horizontal line drawn upon the front face of the pendulum, and, secondly, by the distance it is to the right or left of the vertical line, traced upon the same face of the pendulum. The fibres of the wood are partly wedged in by the ball; but, from the reaction of the circumjacent fibres, very much compressed in the passage of the projectile, the aperture becomes nearly closed, and has the appearance of a long irregular hollow. (I observed that these fibres were generally divided into quadrangular fragments of from $\frac{1}{5}$ to $\frac{1}{4}$ of an inch square.)

We have already explained all the means of ascertaining the extent of the oscillations produced by the shock of the ball. Before a second projectile is thrown, the plate of lead, already pierced by the first ball, is taken off, and the gap in the pendulum is filled up by a round wooden plug, or tompion, driven in with a large iron maul; and the projecting end of this wooden plug is then sawed off, on a level with the front face of the pendulum. Lastly, a fresh leaden plate is put in the place occupied by the

former, having, in like manner, the two lines drawn upon it at right angles, to coincide exactly with those already traced upon that side of the pendulum. The tompion of wood is weighed previously to being hammered in, and the difference between the whole tompion and the end sawed off (which is also weighed) added to the weight of the ball, will give the increase of weight in the pendulum, at the commencement of every fresh round.

When five or six balls have been thus fired into the pendulum, the compression of the fibres of the wood becomes very great, and if the firing were continued, it would be at the risk of splitting the whole. The pendulum is, therefore, dismounted by means of an apparatus, one part of which is affixed to the roof constructed over the pendulum, and the other, to a round cavity in the centre of the axis of the pendulum. The ironing is then removed; the pieces forming the solid parallelopipedon are taken asunder, and the centre one, into which all the balls entered, is replaced by another; after which the elements, composing the pendulum, are brought together again, and the position of the centre of gravity, and of oscillation, the weight, &c. are ascertained anew.

At the conclusion of the experiments, made for the purpose of comparing the common long

guns with the short cannon of Generals Bloomfield and Congreve, four-and-twenty pound-balls were fired into the pendulum. But the shock of balls of this calibre was found to be too great; for, after the second round the ironing of the pendulum gave way, and the several pieces of wood forming the parallelopipedon were disjointed and broken. It seems to me that if the precaution had been adopted of piercing the pendulum by means of an auger, with horizontal holes parallel to the line of fire, the compressed fibres of the wood finding a free space in these cavities, would have partly closed them up, and not have burst asunder the iron work. I proposed this measure to the officers of the arsenal at Woolwich, and it seemed to meet with their approbation. In the course of the experiments, of which we have just spoken, 347·5lbs. of iron were lodged in that block of wood in the pendulum, intended to receive the balls. When the several pieces of wood were taken asunder, the balls in the interior were found to have been broken, by coming in contact with each other; they were shivered into innumerable pieces of all sizes, from the weight of four and six pounds, to mere powder. Although the weight of the balls was, as we have just said, 347·5lbs. on gathering all the fragments, from the largest to those weighing

less than a pound, they did not exceed a mass of three hundred and thirty-one pounds; so that the mutual collision of the metallic particles had reduced their total weight by sixteen and a half pounds, in minute fragments, or powder, too small to be collected, and separated from the dust of the broken wood.

It will be seen by this, that the first balls fixed, being of a smaller calibre, must have buried themselves with moderate force, whilst the two last, as they were twenty-four pound balls, struck the shot already lodged in the pendulum, with an impetus by no means deadened. This produced an extremely violent concussion, the effects of which we have just described; but we shall be inclined to view these effects as still more surprising, when we reflect that, from the use of tompions to fill up the aperture occasioned by each ball, every shot must have had a solid space of wood of considerable thickness to perforate, before it could have reached the one preceding.

Table of Experiments made with the Ballistic Pendulum, 17th July, 1815.

Twelve o'Clock.

Barometer . . . 29·93 Inches.		Commencement of the experiments of the day.
Thermometer · 78° Fahrenheit.		

Three o'Clock.

Barometer . . . 29·9 Inches.		Conclusion of the experiments of the day.
Thermometer . 73° Fahrenheit.		

Space of time in which were 60* vibrations of the pendulum= 115 seconds.

Arc of vibration at the *commencement*,		observed by Dr. Gregory 5° on the upper arc.
Do.	do.	observed by Colonel Griffiths, 5° on the lower arc.
Last arc of vibration	do.	observed by Dr. Gregory, 4° 20′ above.
Do.	do.	observed by Colonel Griffiths, 4° 20′ below.

Weight of the pendulum at the commencement of the experiment, 7441·1235 lb.

Distance of the axis of suspension from the centre		*feet.*	
	of oscillation,	11·88042 before	the experiments of the day.
		11·87892 after	
	of gravity,	10·97133 before	
		10·97542 after	

Strength of the powder.						
Two ounces of powder in the little éprouvette, making thirty small vibrations in twenty-six seconds, the piece having a range of one hundred and seventy-five feet.	Three proofs or trials.	Chords	$38\frac{1}{2}$	40	40
		Versed sines	$7\frac{1}{2}$	8	8
		Arc	$22\frac{1}{4}$	23	23

* That is, sixty *ascents* of the metallic needle.—*Tr.*

Data collected by Experiments made with a Long Six-Pounder.

Weight.	Length of the Gun.	Length of the Bore.	Distance from the Trunnion to the Breech.	Calibre.	Mean Recoil.	Weight of the Gun-Carriage.
Cwt. qr. lb. 12 1 16	Feet. 6	Feet. in. 5 $7\frac{5}{8}$	Feet. $2\frac{4}{5}$	Inches. 3·668	,,	Cwt. qrs. lb. 4 2 0

Species of Gun.	Weight of the Ball.	Diameter of the Ball.	Windage of the Ball.	Windage of the Wadding.	Load of Powder.	Weight of the Cartridge without the Powder.	State of the Thermometer in the Bore.
Long Gun.	lb. oz. drs. 6 1 12	Inches. 3·55	Inches. 0·118	None.	lb. 2	drs. $4\frac{1}{2}$	,,

Distance from the Pendulum to the Mouth of the Cannon.	Distance from the Axis to the Centre of the Hole made by the Ball.	Distance from the Axis to the right or left of the Centre of the Pendulum.	Weight of the Pendulum and Ball.	Arc of Vibration.	Velocity of the Ball.	Recoil of the Gun.	Remarks.
Feet. 30	Inches. 139·884	,,	lb. 7478·9	° ′ 4 33	Feet. 1784·8	Feet. 6·10	Slope of the Platform. $\frac{1}{12}$

The above results were obtained by the firing of the fifth ball, 17th July, 1815.

Formula used in the Calculations.

$$V=\frac{5{\cdot}6727c.}{bi}\sqrt{(pgo+bii).(pg-bi)} = 5{\cdot}6727.c\frac{pg+bi}{bi}\sqrt{o}$$

very nearly.

Elements of the above Formula.

p=weight of the pendulum.
b=do. of the ball.
c=chord of the arc described by the pendulum with the radius i.
g=distance from the axis of suspension to the centre of gravity.
o=do. do. to the centre of oscillation: o is here computed in feet.
i=do. do. to the point where the centre of the ball enters.
v=initial velocity of the pendulum at the point do do.

Time employed by the pendulum in thirty vibrations, after the experiments $56\frac{2}{10}$ seconds.

First arc of vibration observed by Colonel Griffiths=$6^\circ\frac{1}{8}$.
do. do. by Doctor Gregory=$6^\circ\frac{1}{8}$.
Last arc of vibration observed by Colonel Griffiths=$5^\circ\frac{5}{8}$.
do. do. by Doctor Gregory=$5^\circ\frac{5}{8}$.

Distance from the axis to the centre of oscillation 142·561 inches, or 11·88 feet, formed by means of a stop-watch.*

* After this chapter on the late practical experiments made with the ballistic pendulum at Woolwich, the author has a second, of observations upon the theory of the same subject; which, as it is rather a dissertation upon a point of abstract scientific research, than a necessary portion of a work upon "The Military Force of Great Britain," the translator has thought fit to omit, that he might not swell this volume to an immoderate size, by the insertion of a treatise which would seem foreign to the object in view,—that of affording correct general information upon the state of our military establishments.—*Tr.*

CHAPTER IV.

Measurement of Initial Velocity by the passage of Balls across two revolving Disks.

The idea of employing a machine with rotatory motion to determine the velocity of projectiles, was first carried into practice by Robins. In the apparatus used by him for the measurement of the velocity of the ball, and of the resistance it meets with in its passage through the air, the projectile or ball is fixed to the end of a horizontal lever, which turns round a vertical cylinder, the motion of this last being regulated by the descent of a weight. This weight is suspended by a cord, which passes through a pulley and twines itself round the cylinder. The plan we are about to describe is essentially different from that we have just mentioned.

Close to the small building constructed for the ballistic pendulum, two iron axletrees are placed horizontally upon rests, and in a line with each other, in such a manner as constantly to receive an equable motion at the two nearest extremities, which are furnished with teeth for this purpose. These axletrees of iron are intended to carry circular pasteboard disks. When a ball is fired through the disks from a

cannon, the imaginary line along the centre of the bore being parallel to the axletrees of the disks, it is conceived that, if the disks were in a quiescent state, the two holes made by the ball would be opposite to each other, in a straight line parallel to the axis; but that, supposing the disks to be in motion, the centre of the second hole made by the ball would be as many degrees in advance of that of the first, as are contained in an arc described from the same centre as the second disk, and equal in extent to the distance this last revolves during the passage of the ball from the first disk to the second. Colonel Grobert has already availed himself in practice of this simple but ingenious idea. Some time previous, D'Antoni, in his *Examen de la Poudre*, p. 210. described a similar plan, conceived by Mattei, mechanician to the King of Sardinia.

The disks at Woolwich are from four feet to four feet three inches in diameter; and the pasteboard is held, as it extends from the centre, between two flat iron circles in diameter nearly eight inches, and from $\frac{1}{24}$ to $\frac{1}{12}$ of an inch thick; a square rest, firmly fitted into the centre of these two circles, serves to receive that end of the axletree which carries the disk. The circumference of the disk is strengthened with an iron ring from $\frac{1}{8}$ to $\frac{1}{6}$ of an inch thick, and about an inch and $\frac{1}{5}$ broad.

When this kind of wheel is made to revolve rapidly round a horizontal axis, the centrifugal force of the metallic ring, which forms its extreme boundary, occasions great expansion and stiffness in the disk. The ball, in passing through the disk, pierces a hole nearly as true as that made through the leaden plate in the front of the ballistic pendulum; the centre of this hole may likewise be determined with great precision. Before the disks are used, a certain number of concentric circles are drawn upon them, in order to ascertain more easily the variation of the ball from the direction of the axis of the piece, or imaginary line running along the centre of the bore; and, when the disks are mounted upon their axletrees, the vertical diameter is drawn on each, from which line the graduation on the different circles commences. These preparations having been made, the cannon may be levelled at the vertical diameter of the nearest disk, in a direction parallel to the common axis of these disks, which are then set in motion, and the gun discharged.

The following extremely simple calculations will give an idea of the advantage arising from determining the initial velocity by means of such a system. A ball, for instance, which flies at the rate of one thousand three hundred feet in a second, should move over twenty-six feet,

the distance, we believe, between the two disks, in the fiftieth part of a second of time. But the disks of the apparatus at Woolwich have been brought to make eight rotations in a second, that is, two thousand eight hundred and eighty degrees; and this number divided by fifty, gives fifty-seven degrees and three-fifths: a quantity sufficiently great to be measured with an accuracy affording a tolerably correct calculation of the initial velocity of the ball. Thus, it may be seen, that, if the number of degrees which the centre of the hole in the second disk is in advance of the middle of the aperture made by the ball in the first, be taken and divided by the number of degrees revolved by the disks in a second, we shall have the time required by the ball to pass from one disk to the other; and, lastly, the distance between these two disks, divided by the time thus found, will enable us to ascertain the rate at which the ball flies in a minute of time.

After the details we have just gone into, it will be evident, that the thing most difficult to be effected in experiments of this kind, is to give the disks a motion which shall be both very rapid and very regular. The plan resorted to by the officers of the arsenal at Woolwich is, to employ mechanism analogous to that used in the construction of watches; viz. a spring en-

closed in what may be called the barrel, round which a chain gradually winds itself from off a kind of parabolic fusee, whereon it is, in the first instance, wound. This rotatory motion is communicated to a strongly denticulated piece of machinery, which acts upon the contiguous ends of the two axletrees of the disks, and must necessarily impart to each an equal degree of velocity, since the contiguous ends of the two axletrees are denticulated in exactly the same manner and proportion, and are moved by two cogged wheels of equal dimensions, and revolving round the same axis.

Few experiments have yet been made at Woolwich with this disk apparatus; but those, already performed, were very satisfactory, and agreed with the calculations of initial velocity, ascertained by means of the ballistic pendulum. When the disk machinery shall have been perfectly regulated, the results obtained from it and the ballistic pendulum, may be compared, and the experiments of the one be thus made to corroborate those of the other.

BOOK XI.

OF THE PARKS AND ARSENALS OF ARTILLERY.

CHAPTER I.

Parks of Artillery at Chatham and Portsmouth.

If we except the fabrication of gunpowder, the casting of iron guns, the preparation of certain stores, and the repair of some arms and carriages, the works of the ordnance matériel are all, or nearly all, executed at the main establishment—the arsenal at Woolwich. There are, besides, depôts or parks in the fortified places, and in the ports for the royal navy. These last depôts are styled *gun-wharfs*, or *ordnance-wharfs:* they are established near the dock-yards, or marine arsenals, and destined principally for the arming of vessels, but remain entirely independent of the naval department. We shall, in a future work, when treating of the naval force of Great Britain, enter into details upon the connection between the ordnance and naval services; but, at present, it will be sufficient to give an idea of the two principal parks, those of Chatham and Ports-

mouth; there is another large depôt of the same sort at Plymouth.

The park of artillery at Chatham is situated upon the banks of the Medway, between the town of Chatham and the dock-yard. It formerly composed nearly the whole of the naval arsenal, and, for that reason, is often still called *the old dock;* but for a great many years it has been in possession of the ordnance, to which department the admiralty ceded it, on removing the dock farther to the southward: much more recently, the park of artillery has been considerably extended by draining the flat marshy shore, which, on the right bank of the Medway, separated the establishment from the town of Chatham. This great space, which was formerly fetid and unhealthy, is now covered with cannon.

I have already said that the construction of ordnance matériel, instead of being undertaken in the different parks, is almost entirely concentrated at Woolwich. The proximity of that arsenal to the park at Chatham is such, that a vessel can drop down the Medway to Sheerness, and sail up the Thames as far as Woolwich in a single day. It is a consequence of this facility that, instead of leaving the armament of all the vessels, which are disarmed and laid up in the Medway, at the park at Chatham, it is

considered preferable to deposit the arming of but a small number of men-of-war at that depôt, and all the rest at Woolwich. This measure is, besides, absolutely requisite, because the buildings and park at Chatham would not be sufficiently capacious to contain all the armament of the immense quantity of vessels of war which are laid up in the Medway over an extent of twelve miles.

A magazine of small arms, abundantly furnished with the means of supplying the immediate wants of the army and navy, is maintained at Chatham. I remarked in the ordnance magazines a mode of disposing musquets, so as to cause them to occupy a very small space in proportion to their numbers. The musquets stand upright, their but-ends resting in grooves fitted to their shape, on a wooden platform, and the muzzles of the barrels are kept in their places by pegs, also of wood, which point downwards from a frame above, and run into the barrels: the musquets are thus ranged perpendicularly, in right lines, and almost in contact with each other. The upper frame has rectangular compartments and subdivisions, formed by parallel shelves in such manner, that there is a shelf to every row of arms; it is in these shelves that the pegs are inserted which

retain the musquets in a vertical position, and, as each compartment can be raised separately, a certain proportion of the arms may thus be placed or displaced at a time, without disturbing the order of the remainder.

With the exception of two machines, which I shall now describe, and for which the country is indebted to Mr. Nicholson, store-keeper of the establishment, there was nothing particular or new in the park at Chatham, that fell under my observation.

Machine for removing the Rust from Cannon-Shot.—Under sheds in front of the magazines, and on the water side, a machine is employed in taking off the rust of balls, which, from being long buried in the ground, or under water, have become oxidized, and covered with a crust more or less irregular. It is a kind of wooden drum, opening in the convex part by a little door, which serves to introduce and remove the balls. These are put into the machine in sufficient numbers for the operation, and when the drum turns on its axis, by means of two handles at the ends, the balls which are carried up by the rotatory motion, and down to the bottom of the machine again by their own weight, are in continual movement; they rub one against the other, and against circular projections formed

inside the machine; and this constant friction has the effect of completely detaching from their surfaces all the heterogeneous particles which render them uneven and rugged. This apparatus has a good deal of resemblance to the barrels which we use in France to give smoothness to leaden balls.

The other machine is one *for raising cannon*, which is simple, and of great power. It is composed of two parts exactly similar, to be placed to the right and left of the gun which it is wished to raise. Each of these parts is composed primarily of a piece of solid wood upon rollers, with indented iron wheels, &c. raised upon these frames, and so constructed as to work with great facility and effect in attaining the object of the machine.

At certain distances along the quays of the park are fixed cast-iron cranes, acting by the movement of indented wheels, and capable of being checked by a circular curb. These cranes resemble those usually seen in English establishments.

The business of the ordnance park at Chatham is conducted by a storekeeper, clerk of the survey, clerk of the check, and other individuals in employ. In 1815, the *personnel* of this establishment was a charge to the public of £1,445;

but it appears, by the estimates of 1819, that this sum has somewhat decreased by the influence of reductions effected since the peace.

Portsmouth, being one of the principal ports for the royal navy of Great Britain, and the celebrated road of Spithead, between it and the Isle of Wight, being the rendezvous of almost all expeditions, the department of the ordnance find it indispensable to maintain an immense depôt of arms of all kinds, tools, harness, &c. at this station. The park of artillery at Portsmouth is thus, after Woolwich, the grandest and most beautiful of the arsenals of England. It is situated on one side of the dock-yard, and in the town of Portsea, which has risen at the foot of the glacis of the old town of Portsmouth. Towards the harbour the park is bounded by quays, where vessels of burthen and even frigates can lie alongside, to land or embark the materials of armament. Two canals, running at right angles to the quays, and extending to the extremity of the arsenal, admit of vessels approaching whatever part of the establishment is most convenient for their purpose, and thereby save much land carriage in the interior of the park.

On the side of the town, the arsenal is closed by high walls and a massive gate, which is

placed nearly opposite to the centre of the ground. On entering, the stranger is struck with the grandeur of the buildings, and their air of newness: it appears as if the whole arsenal had been built but a year or two. The fact is, that many of the buildings are new, but those which are not are preserved in high order.

In the space allotted for the artillery, the guns are ranged on cast iron supporters, about eight inches high, four inches broad at their base, and two at the top. These supporters, solidly fixed, and placed perfectly level on freestone, sunken into the ground at certain distances, form a double row of great evenness, on which the guns slide with the utmost facility, so that two men can readily manage a gun of the largest calibre upon them.

Among the pieces in this depôt, I observed some new guns upon General Bloomfield's and Sir William Congreve's construction. There are also to be seen, in the magazines of the park, Congreve rockets, mounted upon a sort of double ladder, on which they are made to rest when it is intended to fire them. The four legs of this double ladder diverge in opposite directions, and are more perpendicular in front of the rocket than on the other end. A lock, similar to that for guns, is fixed on the step at

the left behind the rocket; a string, attached to the spring of the lock, hangs down to the foot of the step, where it is taken hold of by the man who fires. At the base of the rocket is a hole made in the iron plate of the projectile, from which the cloth covering the whole is removed, when the fire is communicated to it from the sparks of the priming of the lock. In the same hall where the apparatus of these rockets is placed, there are small pieces of brass cannon with two wheels, and a carriage, the cheeks of which are double to the termination of the part where the gun rests, and in one piece from the cascable to the end of the trail. The whole is so proportioned, that the gun, the wheels, and the carriage can be borne upon the back of a single mule. There are also a great number of portable mortars, such as General Carnot wished to introduce into more frequent employment in France, for the defence of places towards the close of a siege. The hall which contains these mortars, cannon, and rockets, is a large building, intended for the arms of the land forces only; and between it and the other halls there are doors of separation for each, of massive iron, so that if one of them were by any chance to be on fire, the flames could not communicate to the rest.

The stores of the engineer and artillery ser-

vices have their particular halls. All the different materials are disposed in such manner in each hall, as to be embarked with facility at the first moment of need. In the hall for projectiles there are an immense quantity of balls, mounted each upon a wooden shoe, (to form the wadding of the charge,) and held to it by means of two bands of tin, which cross over the ball, and are fastened into the wood. The breadth of these bands is about a quarter of an inch; in France it is made nearly half an inch.

I remarked some balls that were hollow, with an opening or eye passing through the thickness of the iron to the inside of the cavity, and filled with bullets of different sizes. The tin fastening of the shoe to these balls forms a concentric circle round the aperture, and four bands pass from this circle to the wood, leaving the eye clear of them.*

The projectiles are packed in rectangular wooden boxes, some of which contain from six to twelve rounds of grape-shot, and others, tin cylinders filled with balls, and closed at both

* This description in the original can apparently refer to nothing but the Shrapnel shell or spherical case shot; yet it is extraordinary that the author should not have known it by its specific name; or, knowing it, should have omitted to state what the ball he describes is termed.—*Tr.*

extremities; they resemble the French *boites à balles*.

Among the engineer equipage there are scaling ladders, sent from Portsmouth to the Peninsula during the war, and since returned to the arsenal. All the engineer *matériel*, for sapping, entrenching, &c. spades, shovels, wheel-barrows, &c. are ranged in exact order in different apartments, the wheel-barrows dismounted, and the pieces fastened together with rope, so as to occupy the least possible volume. All these materials are thus ready for embarkation.

The harness for the horses of the field train is packed into casks, where it is regularly inspected at short intervals of time. After each inspection the casks are carefully fastened up again; and thus, by this care of its preservation, the harness is always disposable.

It is owing to such admirable order, and attention to *minutiæ*, that during the Peninsular war, and that which followed in 1815, the British were enabled, in the space of a few days, to arm and equip the largest fleets and expeditions. At Portsmouth there are two rooms for small arms, each of which can contain about twenty-four thousand musquets; part of these, and of the swords, bayonets, &c. are exposed to view in the arm-racks, and the

remainder kept in chests. The armament of artillery for the navy is kept in distinct buildings. I remarked a supply of pieces of elm for the cheeks of gun carriages, with the word Woolwich stamped on them, because they had been sawed and squared in that arsenal, from whence they had been distributed among the different parks of artillery. These pieces are used for making gun-carriages at the parks when the arsenal at Woolwich cannot supply them with sufficient expedition, and in the numbers required; but this happens very rarely. I saw again in the park, gun-carriages of cast iron, such as I had previously observed upon the ramparts which defend the entrance of the harbour of Portsmouth. This kind of carriage, which is scarcely ever employed except in the colonies, and for the defence of the coasts, has no other advantage than its durability; it could not be used on shipboard on account of its fragile nature, and the frightful effects arising from its splinters. There are few piles of balls in the park, but each of them is of immense size, sometimes composed of from 25 to 30,000 balls.

In the park of artillery are several houses for the quarters of the officers of the depôt, as well as the storekeepers.

The establishment of the park at Portsmouth is similar to that of Chatham, with a principal

storekeeper, inspector, comptroller, &c. together with clerks and others. In 1815 the *personnel* of the depôt cost 2,245*l.* and the expense has since varied very little.

In 1804, whilst Lord Chatham was master-general of the ordnance, he established, in the parks at Portsmouth and Plymouth, workshops for the repair of small arms, and for the preparation, packing, and dispatching of the supplies necessary to the general service, and particularly to that of the districts of the interior; the object was also to place the country beyond the power of any misfortune of fire at Woolwich to destroy at one blow the workshops of an essential branch of military manufacture.

The same consideration has occasioned the erection of buildings in the vicinity of Portsmouth and Plymouth for airing and rolling damaged powder; a measure which has also the advantage of economy in the expense of transport for the powder disembarked by vessels of war: powder which was formerly carried from these two ports to Woolwich, there to be aired and rolled, and afterwards returned again. There is a foundry for balls for small arms at these powder depôts near Portsmouth and Plymouth.

CHAPTER II.

Establishment and Works of the Arsenal of Woolwich.

The works of the arsenal of Woolwich are divided into four principal branches, dignified with the title of departments.

First: *The Royal Laboratory.* In this department are fabricated or prepared all sorts of ammunition for ordnance and small arms, as well as fireworks required for the land and sea services. The chief of the department is a general officer, styled the comptroller; he not only directs the laboratory of Woolwich, but those also of Portsmouth and Plymouth: as well as the manufactories for powder at Feversham, established in 1784, and at Waltham Abbey, founded in 1788. The next officer to the comptroller has the title of fire-master, and there is also an inspector of powder-mills. The head clerk of the laboratory has the charge of the *materiél*, and the direction of its transport. To give an idea of the grandeur of the works of some of the subdivisions of this department, it may be sufficient to observe that in 1809 the preparation of ammunition required 14,000 yards of flannel, and near 2000 tons of lead.

Secondly: *Military Repository*.—We have already noticed this little department. It is usually directed by the comptroller of the laboratory; and a modeller, a draftsman, and a clerk, are the principal persons employed.

Thirdly: *Inspection of Artillery*.—The director of this department, who is called inspector of artillery, is a general officer charged with the dūty of examining all the *matériel* manufactured by contract, beyond the precincts of the ordnance establishment. He is likewise entrusted with the proof of ordnance, and the foundry of pieces of iron and brass cannon. Assistants for inspection, clerks, and proof-masters, are the principal persons employed under his orders; independently of their fixed salaries, they receive a certain rate for the different proofs of arms.

The foundry of iron cannon is carried on by contractors beyond the establishment of the ordnance, but the brass guns are all cast in the arsenal at Woolwich. All operations which require great powers of motion in the foundry at Woolwich are performed by horses instead of steam-engines. It is surprising that the government works should be behind the private industry of the nation in this respect.

It is only since the regular establishment of the foundry service has had its particular inspector, that this important department has

made a very marked progress in England, both with regard to the proportions of the guns, and the perfection of their casting, &c. In 1797, which was the period when the change took place, of 3,654 pieces of cannon presented for approval, more than twelve per cent. were rejected, either on account of defects of shape and casting, or from having burst in the proof. In 1810, that is to say thirteen years afterwards, the severity exacted in proving cannon had produced effects so beneficial upon the process of fabrication, that, of 5,109 pieces presented, there were not found four per cent. that it was necessary to reject. The India Company and merchants fitting out armed vessels, also prove their cannon at Woolwich.

Fourthly: *Royal Carriage Department.*—It was only as late as 1803, that a distinct department was formed of this branch of the ordnance service, directed by a field-officer of artillery with the title of inspector; before that period the business was in charge of a civil officer termed constructor of gun-carriages and ordnance waggons. The inspector of the department is now seconded by a certain number of officers and master workmen. It was principally the labors of this department of the ordnance which appeared to me to offer examples of remarkable improvement, and I shall

make them the chief subject of the following chapters of this book.

During the late war, there were annually made as many as 2,400 axletrees, with the same number of pairs of wheels, for the gun and other carriages of the ordnance department. In the course of each of the three years 1808, 1809, and 1810, the carriage establishment employed 14,000 cords of timber. It was customary to be provided with such a quantity of wood in store as might be calculated to last for two years to come. The iron used by the department amounted annually to between three and 400 tons, one year with another. In 1809 it required 870 artificers to execute the work performed with the above quantities of materials by the carriage establishment, and they were a charge, for labor only, in twelve months, of £54,526, without including the pay of master workmen and officers.

Without entering more into detail upon the organization of the different branches of service belonging to the arsenal at Woolwich, it may be sufficient to give a table of the annual expenses of the staff of the four departments in 1815, before any reduction had taken place.

Royal Laboratory.

	£.	s.	d.
1 Comptroller	360	0	0
1 Fire-master	230	0	0
1 First assistant ditto	230	0	0
1 Second ditto, ditto	295	0	0
1 Assistant at Portsmouth	200	0	0
1 Clerk	185	0	0
1 Assistant at Plymouth	200	0	0
1 Clerk	185	0	0
1 Inspector of powder mills	200	0	0
1 First clerk	395	0	0
5 Clerks	580	0	0
1 Master workman	118	12	6
	3178	12	6

Inspection of Artillery.

	£.	s.	d.
1 Inspector	350	0	0
1 First assistant	230	0	0
1 Second ditto	310	0	0
3 Clerks	310	0	0
1 Proof master	120	0	0
1 Prover	100	0	0
1 Keeper of instruments	100	7	6
1 Modeller	100	7	6
1 Assistant	91	5	0
1 Inspector of the foundry	91	5	0
1 Master founder	345	0	0
1 Assistant ditto	247	10	0
1 Clerk of works	127	15	0
1 Clerk	115	0	0
	2638	10	0

Royal Carriage Department.

	£.	s.	d.
1 Inspector	400	0	0
1 First Assistant	250	0	0
1 Second ditto	200	0	0
1 Constructor of carriages (chief)	250	0	0
2 Senior constructors	380	0	0
3 Junior ditto	360	0	0
4 Ditto, ditto (out-posts)	490	0	0
1 Clerk, storekeeper	250	0	0

	£	s.	d.
3 Clerks of inspection	260	0	0
5 Ditto of accounts	455	0	0
1 Draftsman	91	5	0
Master Workmen—carpenters	109	10	0
Ditto—cartwrights	219	0	0
Ditto—smiths	328	10	0
	4043	5	0

Royal Military Repository.

	£	s.	d.
1 Superintendent	101	5	0
1 Modeller	120	0	0
1 Clerk	105	0	0
1 Draftsman	308	12	6
	634	17	6

Recapitulation.

	£	s.	d.
Royal Laboratory	3178	12	6
Inspection of Artillery	2638	10	0
Royal Carriage Department	4043	5	0
Royal Military Repository	634	17	6
General Total . . .	10,495	5	0

We shall now offer a short account of the topography of the arsenal at Woolwich. When you enter Woolwich from the London road, following that nearest to the Thames, you first pass the naval arsenal; then, crossing through the town, in the midst of which are rope walks, you arrive finally at the arsenal of the artillery. It is surrounded on the south and west, by lofty brick walls; on the east, by a canal; and on the north, by the Thames. The entrance to this establishment is the centre, where the two roads from London, and that which leads to the barracks of the artillery, and the

military academy, all meet. The admittance to the arsenal is at a large gate, which, however, is opened only for the passage of carriages and of the workmen when passing to and from their labor in a body; but there is a smaller one which is constantly unclosed. A porter's lodge and guard room stand on the left as you pass in, and before you is a large open space decorated with turf and shrubbery, and enclosed within an iron railing like the squares in London. On proceeding towards the left you reach the establishments of the foundry, and farther on, in their prolongation, a line of magazines extending to the river, and the old academy for the engineers and artillery. In the middle of the great street formed by these buildings, is a row of small detached workshops where cartridges and certain fireworks are made up. Opposite to the entrance are workshops for boring cannon, and some other edifices; and, on the right, the quarters of the principal officers of the arsenal. In continuation of this line of houses, you arrive at an immense esplanade covered with more than 10,000 pieces of cannon, and which, I was informed, has contained at a time as great a number as 30,000, independent of quantities innumerable of mortars, howitzers, &c. When the Emperor Alexander visited England, immediately after the peace of 1814, and entered the

arsenal of Woolwich, which he expected to find utterly exhausted by two-and-twenty years of a war that raged and was maintained in all parts of the globe, he was struck with astonishment and admiration at sight of the resources which yet remained to Great Britain.

On the banks of the Thames in front of the esplanade stands a beautiful edifice, composed of three regular buildings of the same size, which form three sides of a square, the fourth being parallel to the Thames. This edifice is one of the magazines of arms and equipage, and in the area which it surrounds are placed enormous piles of cannon shot. The three buildings of the magazine, though isolated by their construction, communicate together by cast iron passages, the floors of which are paved with flagstones, to prevent the progress of fire if it should break out in any one of the three. To the right and left of the establishment of which we are speaking, are situated other magazines of immense extent, disposed with symmetry, and built in a style of regular simplicity.

In front of this imposing mass of architecture is a superb quay, in the form of a polygon, the rectilineal sides of which meet at very obtuse angles. The soil having no consistency, it has been necessary to give the quay a proportionate degree of strength, that it might not sink by its

own weight, and slide into the Thames, as happened with the quays of the dock-yards at Deptford, Woolwich, and Sheerness. In following the course of the river along this quay, you arrive at a canal cut perpendicularly to the river, and forming, as already mentioned, the boundary of the arsenal towards the east. The masonry of the quay, and that of the sluices of the canal, is of Scotch granite, from Dundee, which is brought by sea in immense blocks. The causeways inside the quays, and the jetties of the canal (which includes a considerable space gained upon the Thames) are formed by the sand and earth, raised in the river by means of a cleansing machine worked by steam. Not far from the canal is the building containing the ballistic pendulum, which has been recently employed for some grand and beautiful experiments; and nearly in the same direction, but at a greater distance from the river, stands another edifice, occupied by a steam-engine and the saws which it puts in action. Lastly, in returning towards that side of the place at which the entrance to the arsenal lies, you pass the magazines and workshops of the department for the construction of artillery.

In proceeding to speak more particularly of the labors of the arsenal at Woolwich, it will be recollected, that the establishment has been

already described to consist of three essential departments (exclusive of the little division for models), entrusted with the works relative to armament and ammunition, to the foundry and proof of cannon, and to the construction and repair of gun and other ordnance-carriages. When I visited Woolwich, the peace had suspended the labors of the first of these departments; those of the second still preserved some activity, but they offered me nothing remarkable; for the process of casting brass cannon is very nearly the same in this arsenal and in those of France, and the boring machines have a yet greater resemblance to the old machines, of the sort which were introduced by the Dutch. They are still worked in the arsenal by horses, a circumstance which has, in England, become almost a phenomenon. It is in the machinery used by private individuals for the casting and boring of iron guns, that the process is to be seen in a very great state of perfection. The department of carriages is then, properly speaking, the only one of the three, where I had an opportunity of witnessing some interesting operations; these were in connection with the arts which give a determinate form to wood and metals.

The extremely ingenious machines, by means of which such operations are effected, receive

their rapid movements by the action of steam-engines, and their slow motion, by that of the hydraulic press. The steam-engines are of Maudsley's construction; a man of great professional talent, who, by his unassisted industry, has raised himself from the condition of a simple artisan, to that of the creator and proprietor of one of tne finest mechanical establishments in Great Britain (Southwark.) The steam-engines of Maudsley, which are remarkable for the precision of their labor, and the smoothness and regularity of their movements, have the further advantage, often so important a one, of requiring very little space; the alternate movement, instead of working by the balancing of a long double arm to the lever, oscillating round an horizontal position, operates under the cylinder in which the steam acts, with an eccentric movement reduced to the least space that it can occupy.

The hydraulic press is rather a recent invention; and I will venture to predict that it must produce great improvements in works of art. The action of the machine depends upon this property of fluids, enclosed within solid boundaries; "that, upon every portion of the solid enclosing the fluid, the pressure is equal to the weight of a column of water, of which that portion should be the base, and the distance from

it to the most elevated point of the fluid, the height." Pascal demonstrated this principle and its advantages, by fixing to the upper end of a cask, set upright, a very long and narrow cylinder: in filling the barrel, and afterwards the cylinder, the simple addition of a pint or two of water, which the latter was capable of containing, produced the same effect as if the cask, preserving its diameter throughout, had its height increased by the whole length of the cylinder; thus the increase of weight of a pint or two of water was sufficient to burst the bottom of the hogshead, by the immense augmentation of pressure which it caused. Now, if we suppose the water removed from the cylinder of narrow diameter, and replaced by a solid of equivalent weight, such as a piston, it is evident that the pressure must still remain every where the same. And again, if we suppose that the weight of the piston be multiplied by the power of a lever acting upon its shaft, the pressure will be proportionately augmented, in such manner as to produce upon the bottom of the cask a pressure equivalent to enormous weight, with the exertion of very little primitive force upon the piston.

Bramah, who, possessing great mechanical genius, availed himself of this theoretical idea, has made the happiest application of it to the

aid of the useful arts. He first applied it to the formation of hydraulic presses for copying letters, and then employed such machines for the production of the greatest powers and most important results. These agents are now used for the expression of oils, to compress the matter of paper, to render more compact and less voluminous, all cumbersome articles of naval transport, to press leaf tobacco, and the hay which the English reduce almost into solid masses,* &c.; and, lastly, Bramah has applied his presses to the fabrication of gunpowder, and the works of the gun-carriage department. It is under these last points of view, that we have more particularly to examine the machine.

Notwithstanding the prodigious effects produced by the hydraulic presses, they do not require buildings of extraordinary solidity; they need not even be fixed to any masonry or carpentry, and may be established on small

* In the early part of 1814, a supply of hay packed in this mode was sent out to Passages, for the use of the cavalry of the Duke of Wellington's army.—A portion of it was transported over the Pyrennees on the advance of the troops, brought to Bourdeaux, and from thence shipped, in the summer of the same year, for the horses of officers in the transports which carried some regiments of the army to Canada. In that country masses of the compressed hay, which had not been required during the voyage, were opened, and found to be perfectly sweet and good in every respect.—*Tr.*

carriages, and transported wherever it becomes necessary. These presses have also the advantage of producing their action at the greatest distance from the primitive power, and a simple conducting tube of many miles in length, would transmit the pressure with the same force as if it were only a few yards long. To be convinced of this, it is only necessary to remember that the length of a conducting-pipe is no impediment to the water in finding its level; the slightest additional pressure at one end of a very long pipe must, therefore, preserve its effect almost entire to the other extremity.

Having thus noticed the principle upon which the hydraulic press is made to act, we have to examine its application to works of military art; and first, in this regard, to the fabrication of gunpowder:—

It is well known that the chemical mixtures of which gunpowder is formed, requires very great pressure to augment its compactness, and render it of more strength, than it could otherwise be manufactured. The invention of Bramah has been found its most natural, and, I may add, most advantageous application. The mechanism of this new press does not differ from that commonly used in the arts, in its fundamental principles; but the pump of injection, near which the workmen are placed who

are employed in compressing the powder, is separated from the working cylinder, and from the part of the machine which contains the powder under compression, by a thick wall, intended, in case the powder should take fire, to protect the men serving the pump. The conducting tube, which carries the water from the one cylinder to the other, passes under the wall. It occurred to me, that it would be an improvement, if this wall, which runs in a right line, were to be changed for one in a cylindrical form, having the axis of the injecting cylinder for its centre. By this means, if an explosion were to happen, the wall, by being convex, would present the strength of an arch to resist it; and farther, for an equal extent of masonry the angle, under which the circular part would resist the radii of explosion, would be of much less circumference, and, consequently, diminish the expansive force of the powder against the masonry, in the same degree. Doctor Wollaston, the celebrated philosopher, to whom I communicated this idea, thinks that the effect would be still more certain, if two parallel or concentric walls were constructed. The exterior wall might suffer the first violence of the explosion, the force of which it would break; and even if it did not entirely resist it, there would

be little power left in the explosion to destroy the second wall.

The inert matter of the powder to be compressed is thrown into a rectangular wooden box, lined with lead, and strengthened by copper fastenings; the top is, of course, loose, and the long vertical side, forming the front of the box, can be taken off and put on at pleasure. When in its place, the box is held firm by brass traverses and clamps: it can contain about three hundred pounds of powder; and instead of pressing it in one mass, the plan has been adopted of dividing it into layers of moderate thinness, separated from one another by plates of copper, ranged horizontally. By this method the compression is more easy and complete; and the powder once pressed is broken and granulated more readily and uniformly. When it is wished to place the box on the platform of the press, the workmen approach it by means of a small scaffolding, raised to the height of the platform, which is, at the time, at its least elevation; upon the floor of this scaffold, on each side of it, are grooves, in relief, like those on rail-roads; these two grooves reach the whole length of the floor, to the platform of the press, and along the latter also. The box being placed empty on the floor, is there filled, and the lid

put on it, after which it is pushed on to the platform of the press: the scaffolding is then removed. The timber-work at the top of the press presents a mass of solid wood in relief underneath (and inside the press), a little narrower, and shorter, than the rectangular top of the box.

When the pump or cylinder of injection is made to act, the platform rises—it forces the box up on it; the lid of the box then soon touches the solid mass of timber at the roof, and becomes equally immovable with it. That the box, still gradually forced up by the platform, may continue to rise, it is necessary that the lid shall press in upon the powder, and it consequently reduces it in volume in the manner desired.*

The hydraulic press is also employed in the arsenal at Woolwich, in the operation of packing stores of some kinds. In visiting the fine magazines of the central edifice on the banks of the river, of which I have spoken, I saw an hy-

* The price of such a machine as we have here described, made upon the same dimensions, and with the same care as that constructed for the ordnance department, would be about £400. All the metallic parts of the press are of copper, to guard against danger of fire; and for the above price might be procured, not only the machine, and all its apparatus, but also drawings necessary for a perfect understanding of the whole.—*Author.*

draulic press, established on the floor of the first story, or rather under it. The machine is here used to compress and reduce to the least possible volume, bales of all sorts, clothing, harness, &c. which it may be requisite to forward to the out-ports, armies, &c.

A large and small pump of injection, the former put in action to compress bales requiring great pressure, the latter for such as need less, and which operates in a shorter space of time, are worked manually with a lever, and furnish their water by means of a small canal which comes up to the foot of a strong iron tube, held firmly under the floor by inclined iron braces. The working piston which is in this cylinder supports a metallic platform, and above is a frame of sufficient depth, where several planks are piled to transmit the pressure with some elasticity: there is then a horizontal beam, between which and the platform the pressure takes place; when the platform is lowered, it fits with precision into an aperture in the floor, of which it then appears to be a part.

CHAPTER III.

Works of the Arsenal at Woolwich continued: Hydraulic Press applied to the Planing of Timber; Turning; Sawing.

We have entered into details upon the hydraulic press, as applied to the fabrication of gunpowder and other purposes, but by far the most remarkable use to which it has hitherto been directed, is that of the planing machine for timber. In adapting it to this object, there were a thousand difficulties to encounter, and a great number of essential conditions to fulfil. Against all these Bramah was successful, and the result is to be seen in the arsenal of Woolwich.—I shall attempt a description of the apparatus in question.

An iron horizontal wheel, about ten feet in diameter, is strongly fastened to its axis by cross bars and four iron holdfasts, inclining at an angle of 45°. This working wheel is divided into thirty-two equal parts; at each point of these divisions is a mortice, crossed by the shafts of the cutters. The cutters are bent into half cylinders, the axes of which form an angle of about 30° with the horizon: these are oblique gouges, of very great power. On each side of the axis of the working wheel is a long

carriage, the parallel sides of which retain, in a horizontal position, the piece of timber to be planed; this is securely fixed upon a carriage by a vice: all the gouges are not disposed in such a manner as to form a groove of the same depth. Conceive them grouped by fives and sixes in such manner, that the first of a set, which is most distant from the axis of rotation, makes the shallowest cut; then the second, which is one degree nearer to this axis, produces a groove a little deeper; the third, one deeper still, and so on. This disposition has the advantage of taking off, if required, even less than an inch of the wood, in the most projecting parts of the surface to be planed.

When the thirty-two gouges have made their revolution, the thirty-two furrows which they leave in the wood, have altogether in breadth a space equal to the advance of the carriage during a revolution of the wheel. If, then, the movement of the wheel be very rapid, and that of the carriage very slow, the thirty-two furrows will be contracted into a very narrow compass, and will leave the appearance of a surface as nearly as possible plane. To complete the planing, and give it a finishing polish, a plane is placed on the circumference. When all the gouges have traced their furrows on the wood, the prominent ridges left by the last,

are removed by a single stroke of the instrument just mentioned. This is visible to the eye; each circular gouge, as it passes over the timber, projects a *fan* of dust, and small chips, by the effect of the centrifugal force; the stripes in the wood become more and more numerous; afterwards follows the planing instrument, which causes them to disappear in the glance of an eye, and presents to the spectator a surface levelled with geometrical precision.

If the working wheel, which is ten feet in diameter, were not extremely correct in its movement, the plane would sometimes cut deeper than the gouges, and at others, pass above them without removing the unevenness of the wood. The piece of timber would thus come out of the machine so imperfectly planed as to render it requisite to complete the work by the common process. The axis of the working wheel turns in two hollow cylinders, fixed the one in the floor, and the other under the roof of the building. It is raised a little above the upper jointing, and its head is charged with a lever, having its fulcrum on one side, and bearing on the other a weight to produce a determinate pressure on this axis. The gouges are thus loaded with a weight, capable of enabling them to overcome the resistance of the wood which they are to work upon. The depth

of the furrows being, therefore, the result of an equilibrium between the constant pressure of the gouges, and the variable resistance of the inert surface of the wood, this depth may be a little less at the first passage of the gouges, than when they complete the work at their return by equalizing the parts that are too rough or salient. The breaking or notching of the gouges is thus avoided.

It is often necessary to plane wood of very different thickness, while the height of the carriage, as well as the position of the grooves in which it runs, remain the same; in such case, then, the plane of the gouges must be approached to, or removed from that of the upper surface of the carriage, by a space equal to the thickness of each piece of timber to be worked; this effect is produced by the hydraulic press. The axis of the wheel armed with the gouges turns in a conical hole over the head of a piston, which is itself in the cylinder of an hydraulic press. When water is forced into this cylinder, it raises the axis of the wheel, and with it, the horizontal plane of the gouges which the wheel bears; a contrary effect is of course produced by suffering a portion of the water to discharge itself from the cylinder. An index, moving along a graduated scale, on one of the upright posts near the wheel, marks the thickness of the

wood to be planed; and, therefore, by opening or closing the cock which lets the water in or out of the cylinder, with proper judgment, the wheel can be brought into the position necessary for the work to be executed.

I have said that there are two carriages, one at each side of the axis. They move in different directions; and, when they work together, can be used only with pieces of timber of the same thickness, unless, indeed, supports are placed under that of least dimensions. It is, however, customary to plane the cheeks, wheels, &c. of the gun-carriages of the same calibre simultaneously. The pieces of timber under action are held in the carriages by vices. The height of the working wheel is not the only circumstance determined by the force of the hydraulic press; but the progressive and retrograde movement of the carriages is executed by an effort of the same machine. An endless chain passes into the two grooves in which the carriages run, and crosses one of their cheeks, where it can be fastened by means of an iron vice, the head of which is outside the cheek, to give the power of opening or closing the jaws. When the two carriages are to be drawn at the same time, by the endless chain, the vice-chops in each are closed upon it: when only one carriage is wanted, the jaws which

fixed the second to the chain are opened. This chain winds round a large horizontal wheel, which has on the same axis another, two or three times less, and indented. The working piston of an hydraulic press is provided with a straight and indented shaft, which is placed in a horizontal plane, and catches into the small wheel with teeth, of which we have just spoken. When water is introduced into the cylinder of the press, the piston is pushed up, the indented shaft causes the wheel to move which winds the chain, and the two carriages are set in motion; the one to draw nearer to the press, the other to be carried away from it.

The indented shaft carries at that extremity which is farthest from the piston and cylinder described, a second piston, working in a second cylinder, the contrary effect of which is to retrograde the carriages. This second cylinder being of less diameter than the first, the retrogradation of the carriages is much more rapid than their progressive motion, as it should be, because in the retrograde movement the gouges do not work, and there is no friction to encounter. The velocity of the wheel armed with the gouges, being supposed not to vary, the gouges will have a quantity of work to perform proportioned to the size and hardness of the wood, and the degree in which it is necessary to re-

duce its thickness in planing it; to preserve the same efficacy, therefore, to the efforts of the gouges, it is requisite to render the motion of the carriages more or less rapid, according to the dimensions and quality of the wood under planing.

A discharge-cock gives vent to any portion of the water in the cylinder of the hydraulic press that may be wished, by which means the celerity of the carriages in their progressive motion can be varied at pleasure. The handle of each cock is in the shape of an index, and turns round on a graduated circle. When the cock is completely closed, all the water forced up by the injecting pump serves to cause the maximum of motion to the carriages; when the cock is entirely opened, the water raised by the pump runs out into a reservoir, and the velocity of the carriages become zero. A cock, an index, a graduated circle, &c. are similarly fitted to the apparatus for the retrograde movement of the carriages.

The primary mover of all the system is a steam-engine of six-horse power. Opposite the wall which separates the spaces occupied by the steam-engine and the machine for planing the wood, a horizontal beam of iron, with a circular hole at one end, joints into a circle in relief, and of the same diameter. This circle is

fixed in an eccentric manner on the horizontal axis immediately moved by the steam. The other end of the iron beam is united by a strong peg to the first arm of a bent lever, the second arm of which moves the piston of a sucking and forcing pump. To speak more correctly, there are two pumps moved simultaneously by this action; the strongest serving for the horizontal movements of the carriages; the other for the vertical motion of the wheel armed with gouges; such are the injecting pumps of the hydraulic presses.

It may be seen, from this explanation, that each revolution of the horizontal axis produces a revolution of the vertical axis (supposing the circumferences of the angles which transmit to one the action of the other, to be equal): in the same time, the horizontal beam once raises and lets fall the piston of injection, which is to move the carriages; the quantity of water injected into the hydraulic press is then proportioned with the space revolved upon by the gouges of the working wheel. Thus, whatever be the velocity of the steam-engine which affords the power of motion, the furrows made by the gouges on the wood under planing will have the same dimensions, while the needle of the index, which regulates the velocity of the carriages, remains at the same figure on the dial.

The machine which we have been describing has nothing about its construction which is not perfectly simple, and easy of repair in every part. A small wedge, or vice, is sufficient to remove and replace each cutting tool, when it is wished to change or sharpen it. There are only two movements by indented wheels, and these run easily. Care must, however, be taken, when it is intended to work the wheel armed with gouges, to commence by putting it in motion by the hand, before the circumference of the angle which its axis supports is suffered to catch into that of the axis with horizontal motion; because, the wheel with gouges having a great inert force, if it were all at once to receive the extremely rapid movement given by the steam-engine, the teeth of the wheel would, at the first moment, have an enormous resistance to encounter, and must be shortly destroyed by such violent efforts. The wheel armed with cutters is, therefore, first carefully put in motion by manual exertion, so that at the instant when the steam-engine begins to work, the stress of the teeth upon each other is rendered less violent by the impetus already given to the large wheel.

This machine is certainly expensive in its first cost; but if the little repair which it requires, and the singular rapidity with which it

performs the longest operations, be fully considered, it will readily be conceived, that it is, on the whole, economical to the employer. Immense results can be produced, at a moment of pressing need, with an instrument which will plane, in the greatest style of perfection, and, in a minute or two, each cheek of a gun-carriage of the heaviest calibre, supposing it to have come rough from the workshop of the sawer.

Hydraulic Press for the Boring of Metals.

In the arsenal of Woolwich, a small hydraulic press is applied to yet another use, the boring of metals. A steam-engine puts in motion the borer, which is held vertically, with the point downwards. With one hand, the workman places under the borer, and upon the platform of the hydraulic press, the piece of metal, in which he proposes to form a hole of greater or less depth, while, with the other, he acts upon the lever of the pump of injection of the press, and regulates the movement in such manner that the piece of metal approaches the borer as fast as that instrument proceeds to work into the metal.

Machine for Turning.

In the place where the hydraulic press is applied to the boring of metals, circular planing instruments moved by a steam-engine, are employed in turning the shafts of rammers, spunges, &c. for ordnance, the wooden parts of lances, &c. These instruments are formed of a cylinder, made of copper, of sufficient strength, terminated at one end by a funnel, and cut at about half its length by two plane surfaces, one of which passes through the axis of the cylinder, and the other, parallel to that axis, is distant from it by about one-half of the radius of the cylinder. It is on this last surface, that the iron part of a plane is fixed, the gouge of which passes a little beyond the interior surface of the cylinder, and of the concavo-convex funnel which terminates it. The iron part is held by vices, sunk into the thickness of the copper of the cylinder, so that the iron can be removed and replaced at pleasure, to whet or change it. The cylinder, bearing the planing instrument, is fixed in a raised wheel, which turns upon another without movement, and hollow.

When the machine is put in motion, the workmen take squared laths, rather thicker than the diameter of the tool; one of the men

inserts into the funnel of the cylinder the end of one of these rough laths, and pushes it with his hands, so that it gradually enters the cylinder. The first part of the lath, completely turned, soon begins to appear at the farthest end of the cylinder, when a second workman takes it by both hands, and draws it out to assist the first workman. The longest shaft is thus turned to perfection, and in less than a minute.

If the rough lath, instead of being cut in a right line, is simply square, following the grain of the wood, (be it straight or otherwise) this lath will be still turned, according to the bent of the grain; and the shaft thus procured, which may be afterwards rendered straight by flexion, has all possible strength.

This then is the mode by which shafts are turned, which have the same diameter throughout their length; another apparatus is provided for turning others, whose diameter varies between one end and the other; such are the wooden shafts of the lances for the cavalry, and halberds for the serjeants of infantry, in the British service. In this apparatus, the cylinder which bears the planing instrument is of wood, and of a diameter at least equal to the greatest breadth of wood to be turned. The iron cutter is so constructed as to be brought nearer to, or

withdrawn farther from, the axis of the cylinder at pleasure, by means of a screw. The machine does not revolve; it slides in a groove formed by two parallel supporters. The lath of wood to be worked is let in, at one end, to a square head, which the steam-engine causes to turn; at the other end, the lath rests in a notch formed by a small cross bar, which can be moved more or less towards the extremity of the supporters. In this position the wood is parallel to the supporters.

The movement of rotation is first communicated to the lath, to the unfixed end of which the planing cylinder is held. This end is first turned by the instrument, and is intended for the smallest extremity of the shaft. As the cylinder advances from a fourth to half, from a half to three fourths of the length of the lath, the workman, who with one hand constantly holds the instrument for turning, has a small plate of iron in the other with hollow semicircular apertures, the diameters of which progressively increase. He turns, then, gradually the screw which withdraws the iron cutter from the axis of the cylinder, in such manner as to increase the diameter of the shaft by insensible degrees, and cause it to fill the calibres of the different diameters marked in the plate which he holds.

In the place where these turning machines are established, I observed another for working screws, in which the progressive and retrograde motion of rotation is caused by an alternate catching of wheels disposed in a highly ingenious manner.

Sawing Machinery.

The saws at Woolwich are moved by a steam-engine of twenty horse power. The mechanism of these saws is, as nearly as possible, the same with that of the like machinery at Chatham.* We shall only observe therefore, in this place, that in general the wood sawed for the artillery is of very strong scantling, and extremely hard. It has consequently been found requisite to construct the frames of the saws at Woolwich proportionably strong and large; but, I repeat, that their mechanism affords no essential point of difference from those of the dock-yard at Chatham.

At the end of the apartment where the long saws are established, is another room of less

* The author defers his description of the machinery in question until the publication of the second part of his work, on the "Naval Force" of Great Britain; merely observing, in a note, that these saws are the productions of the genius of his countryman, M. Brunel.—*Tr.*

extent reserved for circular saws, and small straight saws for working cylindrical surfaces. These latter are narrow, thin, and composed of excellent steel. The alternate movement necessary for their operation is communicated to them by a method alike simple and ingenious, which is known under the term of the "Cartwright parallel movement." The circular and other saws we shall describe in the second part of this work, in treating of the Naval force.

Colonel Miller, who is particularly entrusted with the direction of constructing artillery for the navy, employs long saws with the Cartwright movement, to give the requisite shape to cylindrical surfaces; a workman holds the piece with his hand, and gives it a lateral movement, so that the plane of the saw shall be constantly a tangent to the outline, marked upon the wood under operation, as a tracing of the intended cylinder. The progressive movement of the wood is given by the power of motion of the saw itself. Under the bench upon which the piece to be sawed slides along, is a spring, that puts in action a small wheel with numerous and pointed teeth; these project a little above the level of the bench, and grasping the piece of wood to be sawed occasion it to move regularly forward. To assist this effort, there is another wheel exactly similar to the first, but

turning freely, which is placed on the other side of the saw to catch the wood in the same mode. The spring work is so contrived as to produce no tendency in the timber to move, except as the saw descends to cut it; and consequently, when the saw mounts again, there is no pressure from this piece against it.

According as the pieces to be sawed are of greater or less thickness, it is an object of importance to cause them to advance more or less slowly, that the saw may always produce its full effect without embarrassment; the spring work can accelerate or slacken the velocity to be given to the wheels by advancing the fixed point of the lever composing it, sometimes towards the power, sometimes towards the resistance.

To remove at every stroke of the saw the dust which comes from the timber, and which would, when the saw descends again, enter into the cut and injure the movements, Colonel Miller employs a means which we shall describe. The Cartwright movement is underneath the saw instead of being above it; it draws the saw when it works, and pushes it up when it is to rest. The upper part of the saw is held by an iron rod serving as the shaft of a piston, which closes entirely the lower part of a vertical copper cylinder. Near the upper end, this

cylinder is furnished with a valve which, by its weight, has a tendency to open. Lastly, near the top of the cylinder, a small conducting pipe runs from it to the point where the saw issues from the wood in rising after its stroke. This conducting pipe terminates like the reed of a musical wind instrument. When the saw descends and works, a part of the sawdust which it produces falls below by its own weight, and at the same time the upper beam of the saw causes the piston to descend and open the valve in the cylinder. When the saw ascends again, the air in the cylinder reduced to a less volume by the pressure of the piston, first closes the valve, and then, by the effect of its elasticity, the air escapes through the small pipe, and blows away the dust, so that, as the saw is rising, the dust is scattered from about the cut formed by the last descent of the instrument.*

* The circular movement of the indented wheels which move this saw, is communicated by a wooden axis having the form of a ship's yard, hollow, octangular, and hooped with iron; this arrangement allows of the union of the greatest degrees of lightness and solidity; it appears to be of a nature which might often be imitated with advantage in the French arsenals.—*Author*.

BOOK XII.

WORKS OF THE ENGINEER DEPARTMENT.

CHAPTER I.

Defensive Force of Great Britain—Fortifications of Dover, Chatham, Portsmouth, &c.

To prove the power of resistance of which England would be susceptible by the obstacles of nature and of art, I cannot do better than to analyze, and offer the result of, the observations made by the celebrated Lloyd, on this subject. He thinks that a descent upon England could not be made on the side of France, except at Plymouth or Portsmouth, the only points where large and convenient bays could afford a secure shelter for the transports necessary for re-victualling and re-enforcing the army of invasion, as well as for the fleet which should be prepared in case of reverse to attempt and effect their retreat.

Plymouth has the inconvenience of being 218¾ miles distant from London, while Portsmouth is not much above seventy miles from

that capital. The country which it would be necessary to traverse to follow the longest of these lines of attack, is the most mountainous and most difficult, but it has some advantages. By advancing thirty-six miles only, to the right bank of the Teign, the invader becomes master of the peninsula formed by the counties of Devon and Cornwall. Supplies of provisions are secured, the secondary ports of Torbay and of Dartmouth fall into his power, and new points of communication with France are opened to him. There he may maintain his position while his cruizers, dispersed through the seas, ruin the British commerce if the fleets of England are recalled for home defence. But if the naval forces of the belligerents are concentrated for observation upon each other, the invader may choose his time for pursuing the advantages of the contest by land.

But if the descent on Portsmouth be preferred, and that place even captured, together with the island of Portsea, the heights of Portsdown are still before the invader, and must be carried. To march upon London, he must traverse a country of the same nature as that lying between the capital and the banks of the Teign, to which we have been supposing that an army had advanced in the hypothesis that

they preferred the landing at Plymouth. By choosing the descent on Portsmouth, all the forces of the defendants in position between that port and Plymouth would be prepared to take the assailants by their left flank, and render their advance at once difficult and perilous. The country through which the route of the invaders would lie, though it opposes no high mountains, presents no where such large plains as would be requisite for the deployment of a numerous army. It would be necessary to advance by passages often of narrow extent, shut up by hills, woods, rivers, marshes, &c. From Exeter to London, as well as from Portsmouth, all the territory is intersected by enclosures, hedges and ditches; by copses of wood and points of defence of every description; and the road is frequently so confined as to admit of few men marching abreast. This is surely the country of all others most favorable for defence by militia and partizans: for every foot of ground may be disputed by a thousand engagements in detail, without the necessity of ever risking a general and decisive action.

The heights and enclosures being skilfully occupied by the defendants, the invader cannot advance a step; if he once entangles himself, he can never emerge from the labyrinth, and must finish by laying down his arms.

Lloyd then examines the difficulties peculiar to certain passages of rapid streams, rivers, defiles, &c. These details digress from the general plan which we are tracing: after them, the author thus resumes his subject:

"First: The configuration of the ground will force the enemy to advance in a single column; an inconvenience of itself sufficient to counterbalance all advantages. Secondly: the enemy will have few cavalry, and, if the case should be otherwise, the nature of the country will not admit of his using that arm; thirdly, he cannot have heavy artillery, and will possess but a small proportion of field guns compared with the number which the English may readily oppose to him; fourthly, he will have no other supplies than those which he may bring or receive from France, a resource very soon exhausted; fifthly, he will never procure a sufficient number of carriages for the transport of his matériel, and his march must consequently be retarded; sixthly, he cannot form any other magazines or depôts than at the point of debarkation, and the farther he advances, the more difficult will it become to maintain his line of communication, the more necessary to devote troops to this object, who, when appropriated for such a duty, cease to be disposable for offensive operations. Yet it

will be indispensable for him to advance to the last; every prolonged halt must be fatal; seventhly, the enemy cannot send out detachments upon his flanks, or deviate from the great road; the cross-ways and lanes will be all in possession of the defendants, and afford them continual opportunities for partial attacks, capture of convoys, &c."

Lloyd then takes a novel view of the kind of armament and training best adapted to defensive warfare, to which he would have the operations of the natives entirely confined. To form a clearer judgment of the duration of these operations, he gives the distances between London and the principal points on the lines of attack from Portsmouth and Plymouth; between the important stations on the coast from Plymouth to the mouth of the Thames: in short between all the ports of consequence on that part of the English coast which lies opposite to France.

In proceeding to speak of some of the fortresses of England,* I would observe that it

* Immediately before this passage in the original, the author gives an enumeration of the names of the different fortified stations in the United Kingdoms. It is extremely inaccurate, and includes places which it would be absurd to dignify with the term of fortifications in the modern sense of the word. In proof of this assertion, it may be sufficient to state, that the

pertains only to the military engineer of experience to consider all the works undertaken for the defence of a country, in one general view of their absolute and relative value, and thus to produce a correct calculation of the chances of success which the attack of such a country would offer. It would be a task too far above my powers to attempt, and I shall therefore content myself with giving some imperfect notions of places, which I must be considered to have visited merely *as an amateur*, and by accident, in my different excursions. I shall confine myself to an account of Dover, Chatham, and Portsmouth; that is to say, of the three points which cover the capital on the side of France.

The English seem to have regarded Dover as the key of defence of this part of their coast;

palace of Windsor is set down as a *place d'armes;* and that Alderney, Landguard, and the castles of Pendennis, Hurst and Southsea are included among the *fortresses* of Ireland! while the mouldering walls of Chester, and the "antique towers" of Scarborough, St. Maw's, Portland, &c. are seriously introduced among the defences of Great Britain. The enumeration has therefore been altogether omitted in the translation, and the reader carried at once to the author's notice of works which he actually visited. Whatever he had an opportunity of examining in person is always well, and faithfully described; and he is only betrayed into inaccuracies where he is led by the subject beyond the range of his own observation.—*Tr.*

and immense works have been constructed around it accordingly, both at the earliest and latest epochs of history. From Dover to the northward, the sea coast is precipitous for a considerable distance, being formed of calcareous cliffs which the waves regularly undermine, and destroy with considerable rapidity. On the first of these hills, thus worn perpendicularly, is the castle of Dover, an old Roman camp, which William the Conqueror fortified afterwards with much strength. It at present consists of a circumference of walls, flanked by ancient towers, some of which are circular and others square. It is strong only from position, and particularly secure against an attack by sea. In the perpendicular face of the hill, on which the castle is built, casemates have been excavated, for mortars and cannon, to command the sea, and defend the approach to the port, and the sands at the foot of the castle, which are sometimes dry at low water.

On the other side of Dover, is a long hill, at the base of which the town is spread in an irregular line. A magnificent flight of winding steps, with an ascent of above three-and-thirty yards, leads by a postern from the midst of the town to an esplanade in front of a triple range of barracks built half-way up the hill, and looking out towards the sea. These barracks are of

brick, in a simple regular style, and therefore have an excellent effect. Opposite to each range of barracks are isolated kitchens, built at the south side; and, in the same direction, a large guard room, surrounded with a portico of light columns.

In advancing towards the south, there is another sweep of the hill, with a range of new barracks also facing the water. Below these, and at the very edge of the sea, on a small eminence, is a bastioned fort, which by a razing fire protects the entrance to the harbour of Dover. At the foot of this work commences a line of fortifications which follows the commanding range of the hill as far as its crest at the south. On this point, the most elevated of the whole, is a kind of citadel, with magazines, barracks, and casemates. The platform of the hill, which is broad and very long, is entirely occupied by an intrenched camp, the ditches of which are broad and scarped with brick, the walls well raised, and the whole protected by a covert way. Within the line of fortifications, a fine road, with a slope gentle enough for the easy transport of artillery, runs from the south of Dover, and follows the side of the hill, to reach the summit at the gates of the citadel and camp.

There can be no doubt that such a camp as this of Dover would be extremely formidable,

and enable troops, if in sufficient force, and well provisioned, to keep an enemy powerfully and for a length of time in check; but this position, once captured, would become in the hands of the conqueror the best place of arms which he could desire, to secure his stores, facilitate his communication with France, and, in case of a retreat, protect the embarkation and return of his troops.*

In leaving Dover for London, the traveller crosses a dry, irregular, thinly wooded country, offering a number of hills and vallies, but no great natural obstacles until he arrives at Chatham on the banks of the Medway.

At Chatham, the park of artillery already described (Book XI. p. 275.) is not the sole establishment possessed by the ordnance there; that essential military point is provided with barracks, magazines, and fortifications, which,

* If this opinion possess any weight at all, it must apply with equal force to all the strong works in the world, which, when once reduced, bestow upon the assailants, in proportion to their strength of construction, the same degree of security which they previously gave to their original possessors. We might then arrive at the same conclusion as the Emperor Joseph the Second, that all fortifications are worse than useless, because they can scarcely be impregnable. The rapidity with which the French overran the Austrian provinces in the Netherlands, after the said Emperor had wisely dismantled their fortresses, might be adduced as an excellent practical illustration of the soundness of his judgment —*Tr.*

united with the dock-yard and naval arsenal, altogether render it a place of the utmost importance.

Chatham is not defended by any continued line of fortifications, but by a system of isolated works affording each other reciprocal protection. It is only a few years ago that these works were undertaken, or at least finished. The origin of the greater number of them is of the same date as the encampment at Boulogne of the French army which menaced England with invasion. If the operation had been tried, and the troops once landed, they might have reached the heights of Chatham in two days' march, and have possessed themselves without much difficulty, of the ordnance and marine establishments.

To protect these establishments, when Philip the Second threatened England with invasion, and prepared his great armada for the attempt, Elizabeth, who knew the value of the position of Chatham, built the fort known by the name of Upnor Castle, on the left bank of the Medway, opposite to the naval arsenal. Upnor Castle, however, was far from sufficing for the defence of the establishments at Chatham; it did not prevent Ruyter from effecting their destruction in 1667, and carrying off the vessels moored in the Medway. After that disgraceful epoch, the citadel of Chatham was constructed,

as well as the two fronts of works which descend from the citadel to the Medway, the one above, and the other below the park of artillery, and dock-yard. The space enclosed by these works, which may be termed a city from its great extent, contains, besides the two principal objects already mentioned, barracks for the infantry, royal marines, artillery and engineers, as well as a great number of magazines, belonging both to government and to individuals. In front of the barracks of the royal marines, is an exercising ground for the artillery, which has lately been formed for the purpose, having formerly consisted of waste and irregular land which was levelled by the soldiery. To the north of this spot are two parallel ranges of barracks, the lower of which is appropriated for the soldiers, and the upper for the officers of the infantry in garrison: the space between the two buildings serves as a parade for exercise of the infantry.

Above these edifices, and a little to the north on the platform which crowns the hill, are placed the engineer barracks, which by the grandeur and regularity of their construction, by the majestic beauty and simplicity of the architecture, appeared to me to be a model of their kind. In front of the railing which encloses the parade of these barracks, is an espla-

nade of considerable extent. On inclining to the left, you descend towards the front of fortifications which defend the channel of the Medway. This front is raised, and furnished with casemates of two stories, where the soldiers of the engineer department are lodged. If from the terreplein which surmounts these casemates, the eye be directed towards the front so as to look down the river, a defensive tower will be seen on the right bank, similar to those of which we shall attempt a description in the next chapter. If we then quit the grand casemates to follow the line of the works, leaving the river behind, we mount by a considerable ascent to the highest point of the citadel; this part, which is raised artificially, and furnished with works ranged in tiers, and also defiladed, is yet commanded by the prolongation of the hill towards the west. In continuing to follow the direction of the fortifications to approach the town, we turn sharply, and move towards the Medway at right angles to it, by descending steep and irregular passages.

The buildings belonging to the park of artillery are within the fortifications, but the park of guns itself is outside of them, extending like a glacis to the Medway. This point is at the extremity of a deep defile through which ran the old road from London to Dover. The

present road, on leaving Rochester, passes above Chatham.

On the other side of the defile of which we have spoken, stands Fort Pitt, scarped with masonry, and bastioned.* It is the largest of all the works which cover Chatham, the most important, and the nearest to the citadel, the fire of which crosses its own. On the opposite quarter, the fire of Fort Pitt crosses that of Fort Clarence, an immense tower of defence placed on a hill above Rochester. The flanks of Fort Pitt are provided with carronades in frames turning upon pivots to sweep the different parts of the ditch. The gorge of the fort presents a front of fortification, casemated with embrasures, to command in reverse the town of

* In the centre of the spaces occupied by the fortress, there was originally built a defensive tower, armed at the summit with two long guns to batter in front, and two carronades to protect the gorge. This was at the epoch when the rage for building martello towers had seized the British government; they were not contented with placing them on the shores of the sea or large rivers, but even erected them at great expense to form parts of works in the interior of the country. The tower in Fort Pitt is very lofty, and its object is to command at a considerable distance the brow of a hill which raises itself with an insensible slope in front of Fort Pitt. Happily for the fort, this brow is rather narrow, and has deep valleys on each side of it, which would prevent an assailant from giving his approaches any convenient extent.—*Author.*

Chatham, and the course of the Medway, in front of the park of artillery and dock-yard. The casemates are fine and perfectly well constructed; no moisture penetrates into them; and they are at present inhabited by invalids, who compose the only garrison of this fortress.

Fort Clarence is to be considered as one very large defensive tower, of square form, and strengthened by small towers or turrets at the four angles: these turrets contain winding staircases to communicate between the different stories of the work, which has two floors of casemates on the land side, and three or four towards the Medway. Fort Clarence is on a height very near the river, the course of which it protects; and it commands with much advantage the bridge at Rochester, which is the only communication between the opposite banks of the Medway, from that town to the sea. Lastly, the guns of this fort co-operate with those of two or three batteries, which you pass in proceeding up the opposite bank of the river. A covert-way was to have connected the two forts Pitt and Clarence, as well as an intermediate tower, to be erected at the bottom of the valley separating these works; it was also intended to prevent all passage between Fort Pitt and the citadel, by one or two other towers of defence: but, before these numerous

works could be completed, England had ceased to apprehend an invasion, and the execution of them was suspended.

The Medway must be considered as a broad ditch, forming the sole defence for the gorge of the lines which we have described, and which extend nearly three miles. On the bank of the Medway, nearest to the Thames, there are no remarkable works; and the British have satisfied themselves with constructing, as above mentioned, a few intrenched batteries on that bank (to cross the fire of Fort Clarence) opposite to those points of the river where there are fewest natural obstacles to the navigation. It consequently arises from this arrangement, that a daring enemy, passing the Medway above Rochester, where it is much narrower than below Chatham, and posting himself on the left bank, opposite to the ordnance arsenal and dock-yard, might burn the vessels, wooden buildings, and magazines, without striking a blow. But the British suppose that, before an enemy could effect the passage of the Medway, he must have already destroyed the last of their vessels.

The town of Portsmouth, properly speaking, has little extent, and does not contain above 7,000 inhabitants: it is enclosed within fortifications. Beyond the limits of the town are

situated the victualling-office, the ordnance-arsenal, and the dock-yard; which three establishments are all included in the town of Portsea, extending to the northward of that of Portsmouth. It is about fifty years since the undertaking was commenced of enclosing Portsea also within a line of regular works, which, on their left, rest upon the vast bay forming the harbour of Portsmouth, and, on the right, upon the land front of the fortifications of the town of Portsmouth.

These works have half revêtements of masonry; the rest of the rampart is turfed, and the sod kept with so much care, that it is almost as fine as the carpet of admirable verdure which adorns the gardens and parks of England. I saw serjeants superintending workmen provided with scythes and rakes, who were dispersed about the ramparts and other places where there was occasion for their work, while the serjeants remained upon the spot to direct them in the mowing, &c. during all the period of their labour. The embrasures, originally made in the thickness of the parapets, are masked, and the soil with which they are filled up, is covered with sod; the green of which, differing by a slight shade from that of the rest of the parapet, announces a later work. From the exterior country, it would be impossible for the besieger

to divine at what points these masked embrasures are placed. There are guns posted behind most of them, some upon ship-carriages, sliding upon a turning frame after the manner of garrison ordnance. At the salient angles, the interior of the parapet is rounded into a semicircle to receive the gun, and allow of its being more advanced than it could otherwise. Where the interior slope of the parapet is thus cut, the earth is supported by a small brick revêtement, having the form of half a truncated cove, slightly widened at top: this masonry reaches within about twenty inches of the crest of the parapet.*

Portsmouth and Portsea being situated on a soil very little above the level of the sea, the ditches of the works are full of water, which, to

* At the period when I visited Portsmouth, the place was disarmed, and the greater number of the guns on the ramparts were merely standing upon their ship-carriages, opposite to their respective embrasures; few were mounted on the sole, or bottom frame of the carriages. These soles, or frames, may be regarded as raised movable platforms, and are generally quite straight: sometimes, however, they are bent towards the breech of the gun, and the slope is more rapid at that part than at the chase. The object of this form is to give an encreased opposition to the recoil of the piece, and, consequently, to reduce its length; by which means the frame may be made shorter, and a broader space left vacant behind it on the rampart. This disposition, however, has the capital inconvenience of very often upsetting the gun over the fore wheels of its ship-carriage; the breech tumbling over the chase.—*Author.*

prevent any unhealthy effect, is replenished at every tide. In front of the left of Portsmouth, a lake, formed by the sea-water and confined by a sluice, serves to put in motion a large mill, when the tide is out. This mill is situated between the victualling-office and arsenal, and, in time of siege, would supply all the wants of the garrison.

The mouth of the harbour separates Portsmouth and Portsea from a third town called Gosport, of about the same population as Portsmouth. It is surrounded by fortifications which seem to be a continuation of the left front of Portsea, and extend to the lake of Alverstoke, beyond which the magnificent hospital of Haslar is defended by a revêtted and casemated front, which commands the entrance to the harbour and the road of Spithead.*

* The author has here fallen into an error; for Haslar hospital is surrounded by no works whatever; nor has the "revêtted and casemated front" of which he speaks as commanding the mouth of the harbour, any connection with the hospital. The work in question, which is commonly known as "the Block-House Fort," is an isolated casemated battery of heavy guns, placed on the point of land which forms the western side of the entrance to Portsmouth Harbour; and, with the sea-face batteries of the fortress of Portsmouth, completely sweeping the narrow mouth of the harbour. Both this fort, and the *enceinte* of the town of Gosport, are quite distinct from Haslar hospital; and the only remaining work on the Gosport shore is Fort

The defences of Gosport must be considered in relation to Portsmouth, as a tête-du-pont opposed to an enemy advancing from the direction of Plymouth, and debouching from the left shore of the bay of Southamption. In this point of view, the fortifications of Gosport are of the greater importance, as they form the sole rampart before the arsenals and dock-yards of Portsmouth, on that side of the harbour. Round the hospital of Haslar are batteries, whose fire crosses that of very powerful batteries established on the other side of the entrance to the harbour.* These last batteries are armed with guns mounted with cast iron carriages; there are some 42-pounders, and others of less calibre.

Monkton, about a mile and a half to the westward of the hospital, commanding Stokes Bay, and the western approach to Spithead and Portsmouth.—*Tr.*

* This is a repetition of the mistake remarked upon in the preceding note. It is surprising that the author, who saw the full importance of Gosport, to complete the security of the harbour, dock-yards, and arsenals of Portsmouth, should have passed over in silence the inadequacy of the *enceinte* of Gosport to the object desired; instead of corresponding in strength to those of Portsmouth and Portsea, it is scarcely secure against a *coup-de-main;* the ramparts, instead of being revêtted in masonry, are entirely of earth and sod, like field-works; the slopes are, therefore, necessarily gentle, to support the weight of the earth; the escarp is perfectly easy of ascent, and the ditch of so little depth, as to afford but a trifling obstacle to the assailant.—*Tr.*

On the land side, if we extend our observation beyond the line of works, we shall see that Portsmouth and Portsea lie at the southerly angle of a triangular peninsula, of which Portchester lake forms one boundary, the sea a second, and the bay of Langston the third. At the apex of this triangle, where the road to London passes, a canal unites the lake and the bay, and some fortifications by land defend this narrow passage: these are lines of countervallation, perfectly prepared for an assailant who could encamp in the island of Portsea. Beyond these defences commences a slope, at first very gradual, but afterwards rising at a short distance more boldly, until it forms the summit of a range of hills, termed Portsdown, and which extend considerably away.

The crest of this chain of hills is one of the central points marked by Lloyd as stations for corps of observation, in case England should be threatened with invasion on the side of France. It is, indeed, evident that, independently of the advantages of this position, from its situation with regard to places of probable debarkation nearer to the Thames, or in the direction of Plymouth, it would be almost impossible for an invader to attempt the siege of Portsmouth, in presence of a corps of observation encamped on the hills of Portsdown. The besieger would never dare to

shut himself up in the confined island of Portsea, where all communication, all retreat by land or sea, would be entirely cut off. It would be equally difficult and dangerous to march upon Gosport, across a swampy country, where the assailant would be exposed, on the right and left, to the attacks of a naval force in the bays of Southampton and Portchester, while he would be taken in reverse by the Portsdown hills.

CHAPTER II.

*Defence of the Coasts.**

As Great Britain can only be attacked by vessels, or the debarkation of troops, it has been requisite for her to bestow every care upon the fortification of such parts of her coasts as nature had left most accessible; the means resorted to, with this view, have been batteries, redoubts, and defensive towers.

For the harbours and arsenals it was indispensable to construct, first, an *enceinte* of regular fortifications to encircle the station, and, beyond that, a second range of isolated works, well advanced into the country, to secure the stores,

* The facts and dimensions, contained in this chapter and the next, are due to the kindness of Colonel Pasley.—*Author.*

docks, &c. from all danger of a bombardment. For the protection of roadsteads of secondary importance, it was only necessary to erect forts, casemated redoubts, or towers, commanding the entrance.

To guard an open beach, or accessible point, against the landing of an invading army, it has been considered that batteries, supported by towers, are the best defence. Batteries *en barbette* must only be used in points of such elevation, that the gunners cannot be destroyed by the fire of vessels. In a concave bay, where the batteries afford each other mutual protection, if they were constructed *en barbette*, there would be danger of their injuring one another. When the coast is low, and such that vessels can sweep it by their fire, and approach within musquet-shot, the batteries must be covered by a splinter-proof pent-house, to prevent the gunners being killed by a plunging fire from the tops of the enemy's vessels.—A casemated battery, open in rear, is then to be preferred. In a country abounding in wood, a roof of connected beams, covered with about a foot of earth, and supported at intervals by posts, may be substituted with advantage for pillars and arches.

Though land batteries may resist vessels much better armed than themselves, they cannot continue to do so as soon as a landing is

made from such vessels, or even from a single ship: it is necessary, therefore, that for important points, the batteries on the coasts shall be supported by more considerable works. This is sometimes done by adding a ditch with palisades, fraises, &c. to the battery, and closing it at the gorge by a zig-zag loop-holed wall, or a defensive barrack, so as to form a kind of redoubt. A barrack for defence should be a building capable of receiving either all the garrison, or at least a very large proportion of the men necessary for the protection of the work; the roof should be arched, with a terrace above, or, at all events, constructed in such manner, as to prevent an enemy from being able to destroy the edifice by fire.

Use is also made of casemated circular redoubts for the defence of the coasts.—The following are the dimensions of one of these redoubts, built by the British during the last war.

	Feet.
Exterior diameter at the top, about	180
Thickness of the parapets, about	10
Breadth of the *terreplein*	35
Free interior area (diameter)	90
Exterior height of the *revêtement* of the escarp to the top of the merlons	39
The same height, but to the embrasures only	32

The terreplein is prepared for ten guns of heavy calibre, which fire through the low em-

brasures: the interior height of the parapet to the merlons is 8 feet, the banquette is about 3 feet broad altogether: there are isolated traverses between the guns, 8 feet thick, and 15 feet long, placed at about 3 feet from the parapet. The casemates are thirty-five in number, seventeen of which are rectangular, and the others of irregular shape: the irregular casemates have only one ventilator, the others, two. In each casemate is a fire-place, and, in those for the officers, and in the kitchens, two each. Every casemate is closed at the gorge by a wall seven feet thick, with a door and two windows, and a circular bull's eye above the door.—Almost all the redoubt above the level of the floor of the casemates is built of brick, and the lower part of granite, &c.

Martello Towers.

In 1794, the English were struck with the defence made by a round tower on the coast of Corsica, which, with one gun only, obliged two vessels of the line to cease their attack, without having itself sustained much injury from their fire. It was immediately resolved to employ similar towers to fortify the most vulnerable parts of the British coasts, both at home and in

the foreign possessions; but more particularly on the southern and eastern coast of England.

It is useless to attribute to Martello towers properties which they do not possess: their principal advantage is, that they cannot be taken by an assault, immediately following a debarkation; but, with regard to cannonade against vessels at a distance, they are not at all superior to a common land-battery, armed with the same artillery. Thus, in the last war, a simple barbette battery of two guns, situated on an elevated reef on the coast of Naples, beat off a British 74-gun ship, supported by a frigate, and caused the first of these vessels a severe loss in killed and wounded: in despair of being able to silence the fire of this battery, a detachment of seamen was landed, together with another of garrison marines with two field-pieces, and possession soon gained of the battery; which was open, with no other defence than a solidly constructed house in rear, serving as a redoubt, and to which the gunners fled, to endeavour to defend themselves in it by musquetry.*

The defensive towers, styled in England *Mar-*

* The tower of Corsica, cited for its excellent defence, was soon taken when the English attacked it by land, but not before a small battery was thrown up against it.—*Author.*

tello Towers, from the name of that on the island of Corsica, must be at least 30 feet high, that they may not easily be carried by escalade; and the slope given to their *revêtement* should not exceed one twelfth of the height. The diameter of the towers varies from 36 to 52 feet, and is dependant upon the number of guns with which they are to be armed. There are two stories; the upper, to lodge the troops, is covered with one or more arches, made bomb-proof; the lower story should also be covered with light arches, or at least with a floor of incombustible materials; and it is divided usually into three or four small apartments, for the powder, the provisions, the warlike stores, &c.: a small cistern is placed in the lower story, or even beneath it.

Above the bomb-proof vault is a flat terrace of solid masonry, upon which the guns are mounted; it is surrounded by a parapet and banquette.* The communication is preserved with the exterior by a door, placed nearly at the level of the upper story, which is reached by means of a ladder or drawbridge; and, from one story to another, by a trap-door or hatch-

* The total thickness of masonry, above the key of the arch, is rarely less than 5 feet; the ordinary height of the parapet is about 6 feet, and the breadth of the banquette 18 inches.—*Author.*

way in the floor, with a ladder and sometimes, a staircase; and also, by an opening above the entrance-door, either with a ladder or turning stair-case, or, sometimes, with common stair-cases. There are always loop-holes, serving as windows, in the upper story; but there are rarely any exterior apertures in the lowest story, which is aired, by turning ventilators generally continued to the top of the tower. A fire-place and chimney serve to heat the upper floor; and in some towers there is a furnace for making balls red hot: the doors are placed towards the land side, which is regarded as the quarter from whence least danger need be apprehended. For the same reason the towers are of less thickness on that side than towards the sea; and they are occasionally constructed with their exterior forming an ellipse on the land front, while the interior of the masonry is circular.

The Martello towers, and casemated redoubts for the sea-coasts, are composed entirely of masonry, on account of the superiority which the artillery in these works has over that of the vessels attacking them. Walls and parapets, of brick or stone, though not calculated to resist land batteries for any length of time, will remain, without sustaining much injury when engaged against vessels, long after the latter have

been completely disabled. Hard stone, however, ought not to be used for the parapets, if brick or soft stone can be procured, because the first is most liable to throw out dangerous splinters, when struck by shot: for the same reason zig-zag walls, to serve as intrenchments, should never be built of hard stone.*

In the small Martello towers, the bomb-proof vault is often comprised in one dome; in the largest, annular masses of masonry are used; that is to say, the arches spring from two concentric and circular walls, one formed of the exterior wall of the tower, the other being a round pillar, built at the centre of the tower. The profile of the dome, or the vault upon annular masses, may be either a semicircle, a demi-ellipse, a parabola, a segment of a circle, &c.—Sometimes round towers have been covered with common cylindrical vaults, having their axis horizontal; but this is an irregular method.†

* The walls and parapets of towers and casemated redoubts, destined for the defences of coasts, are seldom more than from ten to thirteen feet thick on the most exposed side, and never less than six feet for the weakest parts of the parapets. When the walls are covered by a counterscarp and glacis, as is sometimes the case, the thickness of the masonry is naturally much reduced; care being, however, taken, that it has sufficient strength in the parts which should serve as pillars, or abutments to the bomb-proof vaults.—*Author.*

† At the conclusion of this chapter in the original, the author

CHAPTER III.

Casemates, Powder-Magazines, Pontoons.

In northern climates, the greatest precautions are requisite to prevent the damp from penetrating into the vaults of casemates, in order to preserve the health of the troops inhabiting them, and to render them proper for such stores as it is necessary to keep very dry. All this has been perfected in England.

When a vault has been built of stone or brick, it is completely covered with a waterproof cement, and sometimes for still greater security against wet, the ridges, gutter tiles, and gutters, are all lined with lead. In the gutters small aqueducts are made with a sufficient slope to carry off the water from the *terre-plein*. Two layers of dry bricks are placed over the rest of the vault. In the lower part of the vault, the bricks are arranged in such manner

enters into details of extreme minuteness upon the architectural construction of Martello towers of different kinds, which the translator has taken upon himself to omit altogether; because, to the general military reader, a mere dry table of dimensions would afford no interest; and the engineer, or student in fortifition, will know where to seek for much more complete information on the subject, than could be compressed into the pages of this work.—*Tr.*

as to form narrow canals, affording passages in every direction by which the water can reach the principal gutters; these bricks are covered with pebbles, the lower stratum of which is of larger stones than those above: this bed of pebbles is then covered by one of clay, upon which common earth is thrown, until the *terreplein* is of proper height.—The object of the clay is to prevent the grains of common earth and sand from forcing their way between the pebbles and bricks, thus impeding the issue of the water of filtration. Sometimes the British have, in their casemates, substituted shingle for the two layers of brick; and the casemates, thus constructed, have altogether proved much superior to those built by the French after the old manner, and without the advantage of filtrations.

Formerly, the bomb-proof vaults were semicircular, and sometimes an arc of a circle from 90° to 120°; but the British have often given a preference to the parabolic curve for their arches, having a height equal to half the span. —Such are the new casemates at Dover.

The following are the dimensions of some casemates recently constructed by the British.

First, Left demi-bastion of Fort Ricasoli, at Malta, 36 feet long, 20½ broad; thickness of the piers 7 feet: two doors of communication in each pier, from 5 feet to 6 feet in height,

from the springing of the arches, which are semicircular.

Embrasures $2\frac{1}{3}$ feet above the ground, $2\frac{1}{4}$ feet broad within, and $2\frac{1}{2}$ high; outside, 7 feet broad, and $4\frac{1}{4}$ high; thickness of the escarp wall through which they are pierced, $6\frac{1}{3}$ feet: an air-hole, or ventilator, nearly vertical, is cut in the vault of each casemate, and directed towards the escarp; it is $1\frac{2}{3}$ feet by 2 feet at the summit, and $4\frac{1}{2}$ by 5 feet at the base.

Secondly, These casemates are open at the gorge, with the exception of a thin wall raised only about a yard from the ground: seven of these casemates contain guns of heavy calibre, which, for proof, were fired five or six times as quickly as possible, and the smoke was found to escape pretty freely.

The casemates of the Orange and King's bastions have been found, from long experience, to be very healthy quarters for troops: these casemates are about 16 feet broad, and about as high at the key of the arches, which are semicircular.

The piers are about five feet thick, with a door of communication in the centre of each. The casemates in the King's bastion are about forty feet long, without any opening in the escarp wall, or any ventilator to produce a general current of air. The casemates of the Orange bastion are from about ninety to

ninety-six feet long, each with two loop holes in front on the side of the bay, and three ventilators cut in the bomb proof, which at their opening at top are about four or five feet wide.

Thirdly: The casemates of the new counterguards at Gibraltar are sixteen feet wide, and of different lengths according to the breadth of the rampart, which is irregular. They are about six feet high to the springing of the arches which are segments of circles of 90°. In some new casemates, the last of those constructed at Gibraltar, the breadth is seventeen feet, a dimension which seems more suitable to the lodgment of troops.

Fourthly: The casemates of Fort Cumberland, near Portsmouth, have been inhabited for many years. They are thirty-eight feet long and fourteen feet wide; the piers are three and three quarters feet thick, with two doors of communication in each; the springing of the arches is three feet three quarters above the ground; these arches are segments of circles of 120°. There is a chimney in each casemate, with an embrasure or a loop-hole in front. The average thickness of the roof, from the key of the arches to the level of the *terreplein*, is seven feet and a half. The new casemates constructed at Southsea Castle are also vaulted at a segment of a circle of 120°.

Fifthly: In the casemated cavalier near the left of Chatham lines, the casemates where the troops are quartered are sixty feet long and seventeen wide. They have two stories, the first ten feet below the joists which support the floor of the second; and the latter eleven feet high from the floor to the key-stones of the arches, which are bomb proof and semi-circular. The piers are four feet thick, and in each there is a door of communication to the upper story, with three ventilators for the lower one; the front of the lower story of casemates and piers is buried in the *terreplein* of the lines. Both stories have fire-places and the upper one loop-holes in front.

A wooden gallery, supported by brick pillars, runs along all the extent of the lower story. The roof of this gallery, being secured by a railing, serves as a corridor for the upper story, and is ascended by a staircase at either end. A gallery of this kind, or rather a vaulted gallery for greater security, is very useful in all casemates of two floors; for it not only affords the best means of communication with the upper story, but answers besides for a place of parade in bad weather.

Sixthly: In the works constructed on the western heights of Dover, the principal casemates are about seventy-six feet long by eigh-

teen in breadth. The piers are four feet in thickness, with a door of communication in each; the springing of the arches is eight feet above the ground; the arches are parabolic and of a height equal to the half of their span. There are three fire-places in each casemate, and an embrasure in front.

All the casemates here described, except those of Fort Ricasoli, are closed in rear by a wall with doors and windows.

Powder Magazines.

The English powder magazines are smaller than the French; and when intended to afford considerable space, are composed of two or three connected arches, with doors of communication in the piers.*

The magazine at Upnor, near Chatham, has four arches each eighty-five feet long, and nineteen feet in width, with piers four feet thick, abutments of ten feet, and gables of the same dimensions as the piers. The height, from the

* The powder magazines in France, formed of a single vault with two solid abutments, appear to answer better on trial than others composed of several arches with piers or abutments. The experience of several sieges has put the excellence of the French modern powder magazines beyond all doubt.—*Author.*

level of the floor to the springing of the arches, is nine feet; and the arches themselves have a height equal to half their span, while their thickness is three feet, and the total depth of the masonry to the key-stone above six feet. In each pier there are three vaulted doors of interior communication, five feet wide by seven feet in height. Each division of the magazine has a door and window at either end, and a door besides in every one of the abutments or side walls; there are twenty ventilators in the body of the magazine, eight of which are pierced in the sides of the gutters; sixteen other ventilators conduct the air from the outside under the floor.

The vault is composed of square tiles fixed in common mortar on the masonry of the roof; the gutters only are of lead. This magazine can contain about 10,000 barrels of gunpowder in nine rows of height.

The powder magazine at Tipner Point, near Portsmouth, is constructed of crossed arches. Its dimensions within the four main walls are eighty-seven feet by sixty-one feet. The three great arches in the breadth of the building, having the parabolic form, are each eighteen feet across, and rise at nine feet above the floor, with a height equal to half their span. In the breadth there are two ranges of square pillars,

five feet thick. Following the perpendicular direction, these pillars support transversal arches of the same height as the longitudinal ones, but of a span of five feet only for the centre arch, and of seven feet for the others. There are seven transversal arches, the first and last of which do not rest like the others upon square pillars, but upon abutment piers four feet and a half thick, and six feet and a half long, joined into the walls at the two extremities of the magazine; these walls are five feet thick, and those of the sides six feet. The dimensions of the walls and pillars under the floor are considerably augmented by means of solid projections. There are no layers of masonry above the arches, but the whole building is covered with an arching of wood, and then of double copper.

Two powder magazines built at Plymouth about the same time, with similar materials, have roofs of good timber covered with patent tiles. One of these magazines had a greater slope to its roof than the other, and remained constantly dry and in good condition, while that with a more gradual declivity to its covering was generally damp; and it was found that the timber of the roof began to decay, which rendered it necessary to increase the fall of the slope.

Neither iron nor steel are permitted to be used in the construction of powder magazines, because these metals are subject to take fire by friction or percussion. The floors are composed of strong planks, resting upon joists which are supported by the basement walls of brick, and thus preserved dry; care is always taken to have a currrent of air under the flo The magazines are usually provided with do ble doors, and outside window shutters thick wainscoting, covered with copper. Th ventilators, already mentioned, are likewi covered, both inside and out, with plates copper bored into small holes. Lastly, as final means of security, powder magazines importance have an enclosure wall of from te to eleven feet high, built up all round at th distance of about twelve feet from the walls the depôt.

Pontoons.

The artificers of the English engineer service are employed in turn, as sappers, miners, and pontonniers; never uselessly engaged, they are constantly in activity either in the field or at sieges. On the Medway, a broad and rapid river which is subject to the ebb and flow of tide, they are exercised, as we have already

described, in steering boats and rafts, casting and raising anchor, constructing stationary bridges, and managing others subject to movement from the current of the river. All these operations have been reduced into a regular exercise, for given and varied occasions, showing in what manner exigencies are to be encountered according to the materials which may be at hand in different situations.

As pontoons, the British employ metallic boats, common casks, and cylindrical barrels, terminating in a cone at each end. The first of these, the pontoon-boats, are of tin, with the bottom strengthened by ribs inside to render them capable of supporting the pressure of the water. The sides are hollow, and broader at bottom than at top, being divided into partitions by bulkheads equidistant, and perpendicular to the longitudinal axis of the cavity. The inconvenience of having pontoon-boats of tin is that they cannot be employed in rivers where the tide brings up the salt water without being rapidly destroyed. Several British engineers have been desirous that these pontoons should be made of copper. To this day, however, there has been no change in England since the times of Marlborough, in the construction of pontoons, which always form an article of materiél of much expense. Those used by

the British were copied from the Dutch model of that period, which was extremely well adapted for stagnant waters and currents of little rapidity.

Open pontoons, like the old English ones, are attended with the great inconvenience of being easily carried under by rapid currents, such as that of the Medway, below the bridge at Rochester. Colonel Pasley proposes constructing others of a new pattern; they will be of copper, and decked, and shaped very much like the ferry boats on the Thames, narrow, long, and pointed at the ends. There will be no partitions inside, but, at one end, an apparatus will be formed for pumping up the water at pleasure as it may introduce itself by filtration into the vessel. Colonel Pasley thinks that the water will always force its way into the pontoon so slowly, as to give time for pumping and keeping the leak under. However, if this leak were to be sprung in the middle of the night, the pontoon might be sunk before it was discovered.

The Duke of Wellington, on reaching the left bank of the Adour, caused five hundred men to cross over on pontoons worked with the oar, before a large bridge of boats was laid; this could not have been done with pontoons that were undecked. The great bridge afterwards

laid over the Adour, was constructed in common by the soldiers of the engineers and seamen. It was held firm by cables resting on the boats, and the planks were then fixed to these cables; a plan which could not be followed with advantage wherever a necessity existed of placing the pontoons, or boats serving as piers, at any considerable distance from each other.

The next expedient for forming bridges is by casks. In place of using decked pontoons, by way of avoiding their being carried under by the current of rapid rivers, such as occur in mountainous countries, bridges may be laid upon casks, and these last can, in roads impracticable for pontoon drays, be borne on the backs of mules, or carried in a string upon simple sledges made on the spot. Seven casks, each about a cubic yard in dimension, are equivalent to a large English pontoon; to form of this number a floating mass equal in buoyancy to the pontoon boat for which they are substituted, they are lashed together in a regular manner, in which the officers and soldiers of engineers are before hand instructed. When the casks and the rest of the equipage are brought to the water's edge, three minutes only are requisite to put together each set of casks with very few hands. Then, four men, each with an oar, and two on either side, can row the

machine through the water, while a fifth steers it by one end, also with an oar. The artificers are also exercised in forming bridges with supports, consisting of pontoons and rows of casks placed alternately, and of all dimensions, so that no unforeseen accidents on real service may find the men unprepared with a contrivance to meet the contingency.

When the British troops were in France with the rest of the allied army of occupation, they made trial of a new species of pontoon having two great cylinders terminated by cones instead of one boat of the old kind.

This description of cask is formed of staves of seasoned wood half an inch thick, extending, in one piece, from the end of each cone to that of the other on the opposite extremity. The cask is caulked, tarred, and hooped with twenty-three circles of iron riveted with screws, nine of these circles being on the cylinder, and seven on the cones or the ends.

	feet.
Length of the Cylinder	11
Total length of the Cask	20
Diameter	$2\frac{1}{2}$
Length of each cone	$4\frac{1}{2}$

Nine partitions, perpendicular to the axis, divide the interior into ten parts, lined with plates of very thin copper; the cylinder contains six of these divisions, and each cone two.

If, then, the pontoon is pierced by a ball, the partition into which it enters will fill with water up to the gauge, and the pontoon will doubtless lie a little deeper, but it will not sink. There are means of pumping out the water from each compartment. Every pair of these casks, with an interval of five inches between the two, is fastened above by four cross-beams, and below by four iron arcs of circles lashed by cordage to the beams. The uprights of the beams meet above in two supports for the sleepers of the platform of the bridge, and cleats, nailed on these supports, afford grooves for the sleepers; they are six in number for every pontoon, and are 22 feet long by $3\frac{2}{3}$ inches square. The planks are $10\frac{1}{2}$ feet long, and an inch thick; and the tackle is two inches in diameter. Each raft of two casks, with the beams and planks of its equipment, can support about 7,000 pounds avoirdupoise without being forced under water.

The operations requisite for laying a bridge are performed with a little boat, which is carried with the train. Two sledges, joined by a beam, with two parallel poles running the whole length of the conveyance, and a circular upright for each dray, carry a cylindrical cask of 650 pounds, with beams, planks, &c. weighing above 300 pounds more; and four horses draw the whole with facility. An equipage of this

kind, employed by the British in the grand manœuvres at Famars (spoken of in a former part of this work) followed, at a trot, all the movements performed by the army. A column of cavalry, defiling by threes, passed over a bridge which was laid with this train, without forcing the water mark above the axis of the casks.

In experiments made upon the Scheldt, a twenty-four pounder drawn by eight horses, was caused to pass over a bridge of this description without accident; and by joining cylindrical casks together, a sort of raft was formed which carried troops safely over. There is also a smaller kind of cask used in the British service for the passage of infantry only, about ten feet long, and eighteen inches in diameter. The dimensions of each part of the pontoon equipage in this case are one-half of those of the large casks. A pontoon dray can carry ten of the small casks with their equipage, &c. and the whole being extremely portable, and also not liable to be forced under water by the current of rapid rivers, is an advantageous substitute for the French bridges of light boats. In the manœuvres at Famars, four pontoons of this species formed a bridge on which four files of infantry passed at a time.

In October 1819, some skilful French officers

of artillery and pontonniers made experiments with cylindrical casks constructed on the English model. The results proved not unfavorable to the system, but it was found to be expensive, complicated, and subject to some inconveniences in practice.

FINIS.

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